

IGAC *Activities* NewsLetter

of the International Global Atmospheric Chemistry Project

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In this Issue

A Note from the Chair

2 In Memoriam

- **John Bradshaw**

3 Features

- **Methane Emissions from Landfills**
- **DOE Atmospheric Chemistry Program**

9 Announcements

- **Proposing New IGAC Projects**
- **Inverse Modeling Workshop**
- **S.E. Asia Greenhouse Emissions Workshop**
- **IGAC Symposium in Japan**
- **5th IGAC Scientific Conference**
- **WMO/IGAC Cloud Chemistry Modeling Workshop**
- **WCRP/IGAC Sulfate Aerosol Modeling Workshop**

15 Personnel Notes

A Note From the IGAC Chair

Guy Brasseur

Atmospheric and Climatic Perturbations by the Current and Future Commercial Aircraft Fleet

There is no longer any reasonable doubt that the chemical composition of the global atmosphere is changing. Human activities, and specifically fossil fuel burning and changes in land use, have most certainly contributed to the observed trends in chemical compounds, both at the regional and the global scales. Another potential cause of atmospheric changes is the gradual emergence of a large fleet of commercial aircraft. Today, thousands of aircraft carry several million passengers all over the world each year. At the same time, they release large quantities of carbon dioxide, water vapor, nitrogen oxides, hydrocarbons, and sulfate and soot particles into the atmosphere.

In the early 1970's, Paul Crutzen, Harold Johnston and other scientists suggested that the nitrogen oxides that would be released by a projected fleet of 500 supersonic aircraft would destroy a large fraction of the ozone present in the stratosphere. It was only in the late 1980's that concern was expressed over the impact in the troposphere of the current and future fleet of subsonic aircraft.

The numerous studies of these issues conducted by the scientific community over the last decades have been summarized in several international assessment reports. The latest assessments are by NASA in the U.S. and by the European Union in Europe. An important effort directed by the Intergovernmental Panel on Climate Change (IPCC) is currently underway, and should soon produce a consensus view of our understanding of the problem. Several scientists involved in IGAC Activities are contributing to the IPCC report.

Perturbations by aircraft are difficult to quantify because they include not only gas phase chemical perturbations (such as ozone changes in the upper troposphere and lower stratosphere), but also potential changes in cloudiness and the related climatic impacts. In spite of considerable progress made in our understanding of the chemical and physical processes in the atmosphere, many scientific questions remain wide open. Among them are: What are the natural budgets of chemical compounds including nitrogen oxides and ozone? What are the dynamical processes that determine the dispersion and removal of aircraft effluents, the impact of soot and acids on particle formation and related changes in cloudiness? And, finally, what is the importance of aircraft-induced perturbations on the climate system? These are challenging questions that will require not only internationally coordinated field experiments but also careful data interpretation jointly with model studies.

GLOBAL
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In Memoriam

Dr. John Bradshaw

Dr. John Bradshaw, age 44 and Principal Research Scientist at the Georgia Institute of Technology, died Monday morning, June 16, 1997. Dr. Bradshaw was one of the world's foremost atmospheric chemists, specializing in the application of advanced laser technology to the detection of reactive chemical species in the atmosphere. In addition to being the author of over 90 scientific papers, Dr. Bradshaw served as an advisor and mentor to countless undergraduate and graduate students and was the Chair of the school's Graduate Admissions Committee. He was also a member of the American Chemical Society, Optical Society of America, Society of Applied Spectroscopy, and the American Geophysical Union. In 1993, Dr. Bradshaw received a NASA Group Achievement Award for his contributions to understanding the atmospheric chemistry of the Arctic and Subarctic regions. Probably his greatest scientific achievement was the collection, over a period of a decade, of high-resolution data for reactive nitrogen species in the remote atmosphere using airborne sampling platforms. As a key team member of NASA's Global Tropospheric Experiment (GTE), he played a pivotal role in developing new instrumentation based on two-photon laser induced fluorescence detection. Using this highly sensitive new technique, he and his group generated a global NO and NO₂ data base that represents a unique legacy to the atmospheric science community. Both now and in the future these data will define a critical component of the atmospheric chemical picture that many in the community will grapple with in an attempt to address the growing problem of global environmental change and air pollution.

Directly after receiving his Ph.D. in Analytical Chemistry from the University of Florida in 1980, Dr. Bradshaw joined the faculty in the School of Earth and Atmospheric Sciences of Georgia Tech. He immediately distinguished himself as a talented and tireless analytical chemist and rapidly rose in rank from Research Scientist to Senior Research Scientist and then Principal Research Scientist. At the time of his death, Dr. Bradshaw headed a research group responsible for over \$1 million per year in outside funding and had been recommended for promotion to Full Professor. Dr. Bradshaw is survived by his wife Deborah of Stone Mountain, a Project Director for Planning and Programs in Information Technology at Georgia Tech.

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Features

Measurement and Modeling of Methane Fluxes from Landfills

Contributed by *K.A. Smith, University of Edinburgh, UK and J. Bogner, DOE Argonne National Laboratory, USA*

Methane (CH_4) is an important and relatively long-lived greenhouse gas. Its atmospheric concentration has grown from about 700 ppbv in pre-industrial times to over 1700 ppbv today. It is the only long-lived gas that shows chemical feedback effects: increases in atmospheric CH_4 reduce the concentration of the hydroxyl radical, OH, and thus increase the CH_4 lifetime, and also result in increases in tropospheric ozone.

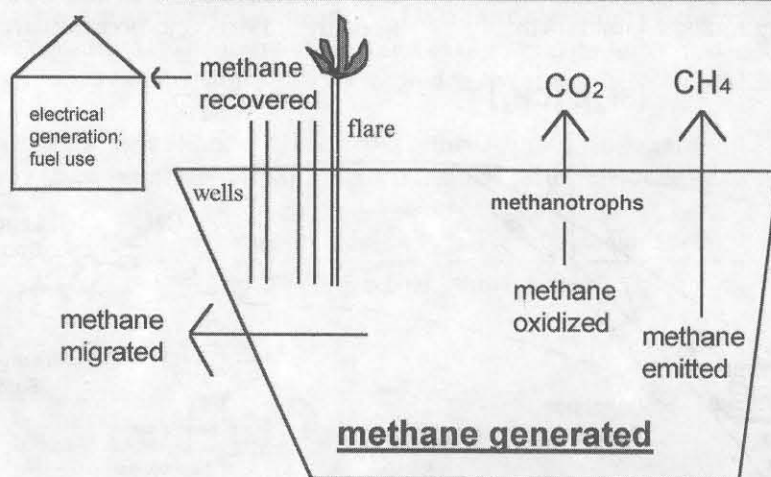
The global annual input of CH_4 to the atmosphere is estimated to be $535 \pm 125 \text{ Tg}$ (IPCC, 1995a), of which about half is considered to be both anthropogenic and originating from biospheric processes, particularly anaerobic bacterial fermentation. Decomposition of refuse in municipal landfills is believed to be one of the major components of this biogenic CH_4 , but past estimates of the emissions from this source have varied greatly, from 9 to 70 Tg yr^{-1} . More reliable estimates are clearly needed, but it appears that

landfills are the largest anthropogenic source of atmospheric CH_4 in the United States and European countries. This source has been targeted in many countries as one which is capable of control by recovery of the CH_4 and using it as a fuel, thus potentially providing a way of reducing current greenhouse gas emissions.

In contrast, in developing countries, urban refuse disposal is often in open dumps, which do not result in much CH_4 emission even though they create a range of other environmental problems. However, as these dumps are replaced in the future by covered landfills it is likely that CH_4 production will increase, and in most cases this will not be recovered for use as fuel or flared, but released to the atmosphere.

Landfills characteristically have two contrasting microbial ecosystems, often with sharp gradients between them: anaerobic methanogenic zones in the refuse and methanotrophic zones in aerated cover soils. Rates for both CH_4 production and oxidation can exceed observed rates for other terrestrial ecosystems by large factors. Field flux measurements (net emissions) vary over 7 orders of magnitude, from less than 0.0004 to about $4,000 \text{ g m}^{-2} \text{ d}^{-1}$ (Bogner et al., 1997).

Landfill Methane Balance



$$\text{methane generated} = \text{methane emitted} + \text{methane oxidized} + \text{methane recovered} + \text{methane migrated} + \Delta \text{ methane storage}$$

Figure 1. Landfill methane balance (Adapted from Bogner and Spokas, 1993).

These net emissions, of course, are the result of CH_4 production, oxidation, and gaseous transport processes in the cover soil. The various pathways into which landfill methane is partitioned are shown in Fig. 1, which illustrates that both methanotrophic oxidation and engineered control systems (pumped gas recovery) may reduce emissions.

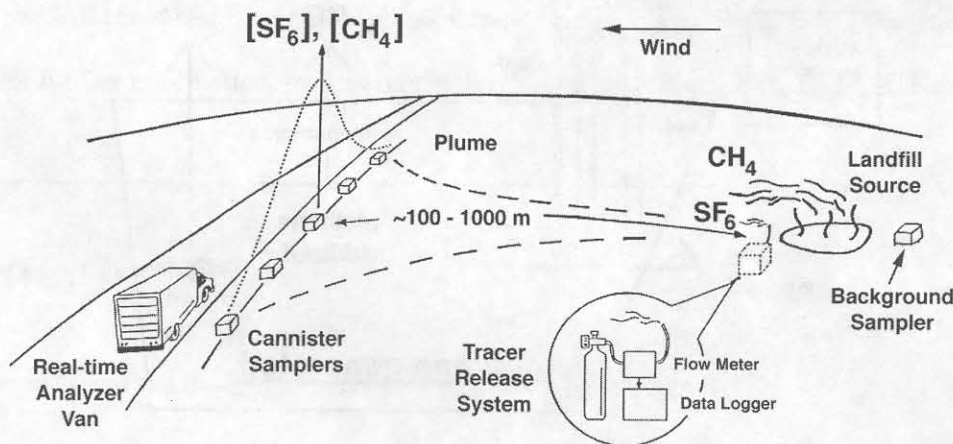
Compared with more well-studied sources, mechanistic understanding of how specific physical and biochemical controls affect net CH_4 emissions from landfills is poor. Hence, it is difficult to predict emission rates at sites with various cover types, climatic regimes, and management practices. CH_4 oxidation in cover soils requires further study to determine its impact on net emissions. Oxidation rates in these soils range up to over $100 \text{ g m}^{-2} \text{ day}^{-1}$, among the highest for any biological system, and in some cases, the landfill can be a net sink for atmospheric CH_4 oxidation. Emissions of other greenhouse gases, such as nitrous oxide, and aromatic and chlorinated compounds of environmental concern, also occur, but not much is known about flux rates.

Up to now, "top-down" approaches have been used to estimate CH_4 fluxes from landfills. The quantities and types of decomposable refuse deposited have been calculated, and multiplied by assumed rates of CH_4 generation. However, such estimates have not taken account of many factors which affect net emissions, and there is a need to be able to quantify these emissions by field measurements, to validate the top-down approach. As a contribution to this objective, IGAC's Trace Gas Exchange: Mid-Latitude Ecosystems and Atmosphere (TRAGEX) Activity organized a joint North

American-European Workshop at the Argonne National Laboratory, USA, on October 21-24, 1996, to establish the state of the art in field measurement and modeling of emissions, and to identify major research and scaling issues that have to be tackled to improve global estimates for input to climate models. The workshop involved participants from nine countries, and was sponsored by the European IGAC Project Office, NASA, Argonne National Laboratory, and the U.S. Environmental Protection Agency Landfill CH_4 Outreach Program.

At the workshop, an overview of current work was given through invited presentations and a poster session. The presentations dealt with current global estimates, measurement methods, particularly chamber methods and micrometeorological techniques, oxidation studies, and isotopic techniques for characterizing microbial CH_4 processes. The remainder of the workshop consisted of three working sessions focusing on measurement strategies; on ancillary soil studies; and on modeling, scaling, and inventory issues. The principal conclusions are summarized below. A full report of the workshop has recently been published (Smith and Bogner, 1997) and is available on request from the IGAC Core Project Office.

Emission data can be obtained by chamber, inert tracer, and micrometeorological methods. All these methods have inherent advantages and disadvantages, but are not uniformly applicable to all landfill types; preferably different methods should be used in combination. To date, most measurements have been by static chamber methods, which have also been used to determine net uptake of atmospheric CH_4 (Whalen and Reeburgh, 1990), and occasionally to measure emis-



$$Q_{\text{CH}_4} = Q_{\text{SF}_6} \cdot \frac{C_{\text{CH}_4}}{C_{\text{SF}_6}}$$

Figure 2. Use of tracer (SF_6) for field measurement of landfill methane emissions. (Czepl and Mosher, unpublished).

sions of nitrous oxide and nonmethane hydrocarbons from landfill surfaces.

Tracer methods involve the release of an inert tracer gas, most commonly sulfur hexafluoride (SF_6), from points along the upwind edge of the emitting surface, to simulate gas emission. If the released tracer is well mixed in a source "plume" and if the CH_4 concentration in the plume differs sufficiently from background atmospheric CH_4 , then the emission rate can be obtained directly, using a ratio method (Fig. 2).

Tracer methods circumvent the problem of spatial heterogeneity by integrating the whole area flux and are therefore a favored method for estimating emissions for whole landfills. However, their high cost, dependence on meteorological conditions, and potential for interference from other sources of CH_4 limit their applicability. Only two micrometeorological methods — eddy correlation and flux gradient — have been applied so far. These methods can be used to evaluate whole-landfill CH_4 emissions, and because they are more automated, they are especially useful for the study of diurnal and seasonal flux variations. However, they require complex instrumentation and calculations, and also have surface constraints (relatively level terrain) that may limit their application.

New methods have been proposed (e.g., Fourier transform infrared methods with dispersion modeling), but have not yet been applied to landfill studies. Because previous investigations have shown significant spatial variability at a given site, major research needs include effective screening tools — simple portable gas analysers — to aid experimental designs; a systematic comparison of various methods under both controlled conditions and full-scale field conditions; and basic studies on the variables controlling gaseous emissions.

Considerable attention was given to the effect of methanotrophic CH_4 on net emission versus gross production, and possible isotopic approaches to quantify this relationship. Important variables include soil texture, gas-filled and total porosity, tortuosity, dynamic water content and moisture-holding capacity, clay mineralogy, and nutrient and organic matter content. For example, in landfill soils containing organic matter with a low C/N ratio, CH_4 oxidation can be suppressed because of increased nitrogen turnover. Soil cover design and management practices are also important.

Isotopic methods (both ^{13}C and deuterium (D)) are especially attractive for quantification of CH_4 oxidation in landfills. As CH_4 is oxidized, the lighter isotopes are used preferentially, leaving residual CH_4 enriched in both ^{13}C and D. The d^{13}C for CH_4 in the anaerobic zone

is about -50 to -60 ‰ and the dD about -285 to -325‰ (Bergamaschi and Harris, 1995). The isotopic shift is proportional to the fraction of CH_4 that is oxidized and the degree of preference of the microbes for the lighter isotope. Measurements of the shift have been used with success to estimate the fraction of CH_4 oxidized in wetlands, and have an obvious application in analogous landfill studies. Identifying the depth of maximum CH_4 oxidation would assist with determination of a minimum cover thickness and other properties needed for optimum oxidation.

The workshop also addressed issues associated with modeling landfill CH_4 emissions at various scales, including the development of improved global inventories for input to climate models. In particular, the problem of scaling up from specific site studies was discussed with reference to suggested protocols for future site classification and inventory purposes. Three methods are currently being used: (1) the U.S. EPA system using current estimates of per capita refuse generation and landfill disposal in a first-order kinetic model for CH_4 generation, without CH_4 oxidation (Doorn and Barlaz, 1995); (2) the UK approach (Aitchison et al., 1996), also based on a first-order model, which considers numerous factors shown to be important for CH_4 emissions over time (pumped gas recovery; refuse composition; CH_4 oxidation); and (3) the current IPCC approach (IPCC, 1995b), which assumes steady-state CH_4 generation on the basis of the degradable organic carbon content of landfilled refuse.

The improvement of models to estimate global emissions depends on the development of more refined methods, as well as improved inventories for waste generation rates, waste composition, organic carbon conversion, and CH_4 recovery. The extrapolation of results from small-scale studies to estimates of national or global emissions is difficult. The current models used for global estimates have not been validated by field measurements for either net CH_4 flux or CH_4 oxidation rates. Recommendations for scaling up include the direct use of available CH_4 flux or oxidation data where available. For many locations, national estimates could be improved through development of algorithms inclusive of specific management practices (above-ground or below-ground sites; gas recovery or no gas recovery), landfill size (gross size and surface-to-volume ratio), and realistic rates for CH_4 oxidation. An improved methodology was suggested (Fig. 3) that incorporates these factors for countries where solid waste statistics are available. As such approaches are adopted and field measurement programs are completed, there is reason for optimism that "top-down" and "bottom-up" approaches may be reconciled.

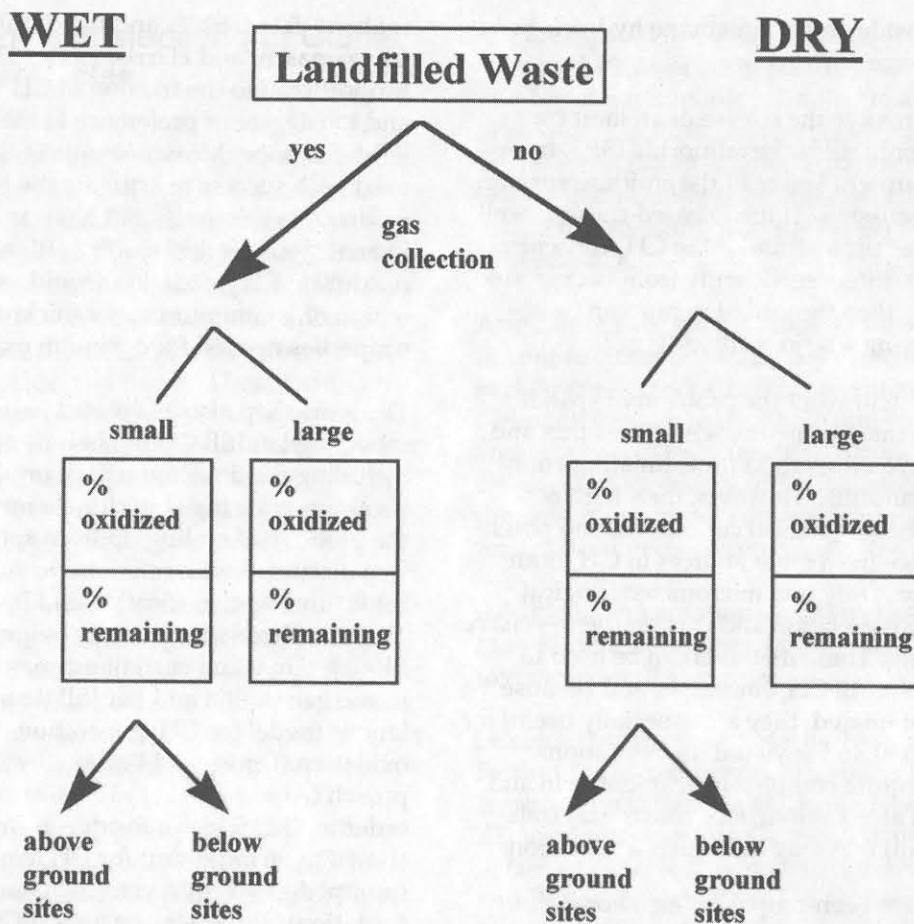


Figure 3. A conceptual model for improved quantification of country-based landfill methane emissions. This model is for developed countries with available solid waste and landfill management statistics. The primary criterion is wet vs. dry sites (based on the moisture content of the bulk landfilled waste), the second tier criterion is the presence or absence of pumped gas recovery, the third criterion is size (small vs. large), the fourth criterion is fractional methane oxidation, and the fifth criterion relates to site construction (above-ground vs. below-ground at small sites)

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The U.S. Department of Energy's Atmospheric Chemistry Program (ACP)

Contributed by *M.L. Wesely*, DOE Argonne National Laboratory, USA

The Atmospheric Chemistry Program (ACP) is a Global Change Research program sponsored by the Environmental Sciences Division of the U.S. Department of Energy (DOE). The ACP supports research at DOE laboratories, non-DOE government laboratories, and universities with the overall objective of providing information on the atmospheric environment that is required for long-range energy planning by the DOE. The thrusts of this research during the past few years have been on regional and continental chemistry and fate of tropospheric air pollutants, extracontinental and global chemistry and fate of tropospheric air pollutants, stratospheric ozone and ultraviolet-b radiation, and genesis of aerosols associated with climate change issues. Laboratory studies emphasized rate and equilibrium processes. Field studies were conducted with aircraft and surface measurements on reaction chemistry, advective influences on the chemical composition of chemistry, and air-surface exchange processes. Modeling efforts addressed both chemistry and dynamics on regional and global scales.

Considerable information on the ACP can be found on the World Wide Web at <http://www.atmos.anl.gov/ACP>. Information is provided on active projects, the Gulfstream-I (G-1) research aircraft, publications by ACP participants, past ACP annual meetings, and links to ACP-related efforts.

The ACP was initiated in 1991 to coordinate atmospheric chemistry research support by DOE at universities and federal laboratories and to focus these efforts on national and international information requirements regarding atmospheric chemistry. A list of current participants is given in the accompanying table. During 1998, the ACP will be partially restructured. Research on oxidants, aerosols, and their precursors will be emphasized and will address transport, transformation and removal processes. While tropospheric processes are of primary interest, stratospheric phenomena will also be considered. The research will fall into four general categories:

1. The causes of regional variations in tropospheric concentrations of ozone and other oxidants, including areas that experience non-attainment of U.S. ozone standards, will be investigated. Modeling, theoretical, and experimental efforts to address regions of different mixes of atmospheric trace chemicals and atmo-

spheric transport conditions will be involved. While further studies in the northeastern U.S. will be considered, conditions in areas such as the southwestern United States will be studied in future years. The goal of this work is to develop reliable models of tropospheric oxidant concentrations over regional scales.

Several studies on oxidants and other trace chemicals have been conducted by the ACP during the past several years, mostly in the northeastern U.S. and often in collaboration with the North American Research Strategy for Tropospheric Ozone (NARSTO) program (see <http://narsto.owt.com/Narsto/>). Future collaborative efforts with NARSTO are anticipated. The ACP efforts are expected to focus on the sources of variations of ozone, other oxidants, and their precursors. Experimental studies and modeling efforts are likely to be extended to address diverse atmospheric conditions. Studies of nighttime as well as daytime chemistry involving oxidants and nitrogen oxides are needed. In such studies, the dynamic atmospheric conditions that affect chemical reactions must be considered. Development and deployment of advanced field instrumentation not otherwise available to make surface and aircraft-based observations necessary for these studies will be pursued.

2. In conjunction with oxidant studies, the causes of variations of tropospheric aerosol chemical composition and concentrations will be investigated, particularly with regard to existing or proposed particulate matter standards and visibility. Collaborative studies will be encouraged. For example, collaboration might be sought with the DOE Atmospheric Radiation Measurement (ARM) Program on aerosol characterization experiments emphasizing particle chemical composition as a function of particle size. Modeling studies will focus on methods of estimating aerosol composition over regional scales.

3. Heterogeneous processes will be studied that affect chemical rates of reactions involving oxidants, nitrogen oxides, and sulfur oxides. One aim is to develop measurement capabilities that could be used in future field studies of heterogeneous processes.

4. Observational and mechanistic studies of ozone fate and resulting consequences in the mid-latitude free troposphere and the lower stratosphere will be investigated. Some emphasis will be placed on stratosphere-troposphere exchange as it affects oxidant concentrations in the lower troposphere. Observational studies are expected to include completion or extension of ACP studies of total columnar ozone trends and the resulting behavior of surface ultraviolet radiation.

Summary of Current ACP Participants by Organization

Organization	Primary Activities Within ACP
Argonne National Laboratory	<ul style="list-style-type: none"> • Atmospheric photochemistry measurement and interpretation of organic oxidants and volatile compounds • Trends and extreme values of stratospheric ozone amounts • Air-surface exchange measurement and modeling • Scientific coordination of ACP
University of Arizona, Tucson	<ul style="list-style-type: none"> • Stratospheric ozone and temperature trends inferred from satellite data
Brookhaven National Laboratory	<ul style="list-style-type: none"> • Field studies and theoretical interpretation of tropospheric photochemical processes • Heterogeneous and aqueous phase chemistry measurements in the laboratory and interpretation • Modeling of chemical and microphysical behavior of aerosols
Boston College	<ul style="list-style-type: none"> • Interfacial mass transport: laboratory measurement and interpretation
University of California, Irvine	<ul style="list-style-type: none"> • Laboratory studies of tropospheric ozone and sea salt aerosol
Cascade Scientific Research Corporation	<ul style="list-style-type: none"> • Transfer of information between atmospheric research and energy policy assessments
University of Colorado, Boulder	<ul style="list-style-type: none"> • Improved methods of inferring stratospheric ozone amounts and profiles from satellite data
Envair	<ul style="list-style-type: none"> • Management coordination of the North American Research Strategy for Ozone program • Modeling of long-range transport of energy related pollutants in the lower atmosphere
Environmental Measurements Laboratory	<ul style="list-style-type: none"> • Field measurements and characterization of aerosols and of radon and radon progeny
University of Iowa, Iowa City	<ul style="list-style-type: none"> • Modeling and theoretical studies of interactions of ultraviolet radiation, ozone, and aerosols in the troposphere
Lawrence Livermore National Laboratory	<ul style="list-style-type: none"> • Theoretical studies of global tropospheric and stratospheric ozone • Global atmospheric chemistry modeling
Mission Research Corporation	<ul style="list-style-type: none"> • Sensitivity and uncertainty analysis of stratospheric dynamics models of involving ozone
National Oceanic and Atmospheric Administration	<ul style="list-style-type: none"> • Development of improved methods to infer stratospheric ozone profiles from remote sensing techniques • Quality assurance techniques on air and precipitation networks operating in the Americas
National Center for Atmospheric Research	<ul style="list-style-type: none"> • Global modeling of ozone in the free troposphere and the stratosphere • Ultraviolet radiation climatology near surface of Earth
University of Michigan, Ann Arbor	<ul style="list-style-type: none"> • Global atmospheric chemistry modeling

University of Minnesota, Minneapolis	• Aerosol nucleation and growth measurement & interpretation
State University of New York at Albany	• Modeling of ozone processes in the stratosphere and free troposphere and global radiative forcing
State University of New York at Old Westbury	• Field measurements of atmospheric peroxides
Pacific Northwest National Laboratory	<ul style="list-style-type: none"> • Field measurements and analysis of photochemical mechanisms and transport processes • Research aircraft facility • Modeling of direct radiative forcing by aerosols on global scales • Development of surface ultraviolet radiation surface spectrometer
Research Support Instruments, Inc.	• Spectroradiometric calibration of devices used for remote sensing of stratospheric ozone amounts and profiles
SRI International	• Sensitivity and uncertainty analysis of atmospheric ozone photochemistry models

Announcements

Getting Involved: Proposing New IGAC Research Projects

Over the past year or so the IGAC Core Project Office (CPO) has received inquiries from individual scientists regarding how research projects they head or are involved with can be endorsed by or potentially be incorporated formally into IGAC. The IGAC Scientific Steering Committee (SSC) approved the following guidelines for "proposing new IGAC research projects" during its meeting in Toronto, Canada, in May of this year:

IGAC is implemented at the Activity level, so "proposals" for new IGAC research projects should be directed to the Convener or Convener(s) of the IGAC Activity to which the project may contribute. Information copies should be sent to the CPO and, if the project is regionally focused toward Europe or South Asia, to the European IGAC Project Office (EIPO) in Ispra, Italy, or to the South Asian IGAC Project Office (SAIPO) in New Delhi, India, respectively. The addresses of these offices are given below. If the principal


investigator is unsure about which Activity is most relevant, s/he should send the proposal just to the CPO initially. If necessary the CPO will seek guidance from members of the IGAC SSC and then advise the investigator how to proceed.

Proposals may be submitted at any time. They should be brief and concise—a maximum of five single-spaced pages—and should include: i) the scientific rationale for the research, ii) a statement of goals, iii) a synopsis of the implementation strategy emphasizing how the proposed research may help the relevant IGAC Activity or Activities achieve its/their scientific goals, and therefore advance IGAC toward its overall goals, iv) an implementation timetable, v) an outline of a plan for data quality assurance and archiving, vi) a description of the international nature of the project (at minimum a list of expected co-investigators and their affiliations), and vii) a description of how the project might encourage capacity building in atmospheric-biospheric chemistry, particularly in lesser developed countries (see IGAC Activities Newsletter, Issue No. 3, pp. 6-7, Jan. 1996). (See next page for IGAC office address).

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International Symposium on Atmospheric Chemistry and Future Global Environment

Nagoya, Japan - November 11-13, 1997

Organized by the Science Council of Japan and the National Space Development Agency

OBJECTIVES

According to human activity, chemical composition of the atmosphere has been changing rapidly. Increase of the concentrations of greenhouse gases, oxidants and aerosols is a direct cause of global environmental change. Atmospheric chemistry which aims to study the global change of the atmosphere is a rapidly growing research field and better communication of scientists worldwide is essential for successful achievement of IGAC and IGBP. The purpose of this IGAC/IGBP symposium is to summarize and enhance our knowledge of current acidity of atmospheric chemistry and future global change, and to enhance communication between scientists in Asia and the rest of the world in this field.

GENERAL INFORMATION

The Symposium will be held at Nagoya Congress Center. The registration fee is 10,000 Japanese Yen (approx. US\$90) including extended abstracts of the Symposium and reception.

*Special Guest Speaker: Dr. Paul Crutzen
Max-Planck-Institut für Chemie, Germany*

SYMPOSIUM PUBLICATIONS

A volume of extended abstracts will be distributed at the Symposium.

DISCUSSION THEMES

- Session 1: Material Cycles of Greenhouse Gases (Convener: T. Nakazawa, Touhouku University)
- Session 2: Tropospheric Photochemistry and Ozone Budget (Convener: Y. Kondo, Nagoya University)
- Session 3: Aerosols and Their Climate Impact (Convener: K. Kawamura, Hokkaido University)

IMPORTANT DEADLINE

15 September 1997 Extended abstracts

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Synthesis Workshop on Greenhouse Gas Emissions, Aerosols, and Land Use and Land Cover Change in Southeast Asia

National Central University, Chungliu, Taiwan
15-18 November 1997

In the last few years, national and international institutions in Southeast Asia launched parallel initiatives to identify/quantify sources and sinks of greenhouse gases (GHG) to reduce the uncertainties of global change. Projects included national inventories of sources, sinks, and estimates of greenhouse gas emissions; identification of biophysical and socio-economic drivers of land use and land cover changes; aerosol concentrations and processes that influence atmospheric chemistry and attenuate solar radiation reaching Earth's surface, thus producing negative feedback to global warming; modeling studies that aimed to get an early snapshot of the whole global change scenario by integrating currently available data and information; and the political implications of transboundary air pollution transport as most countries proceed with rapid urbanization and industrialization. The aforementioned projects have produced a source of diverse data, information and knowledge on GHG, aerosols, land use that will be brought before a forum of global change scientists and experts for analysis and definition of requirements for further use and interpretation.

At the invitation of the IGBP National Committee of Academia, China-Taipei, and in fulfillment of UNDP/GEF grant objectives, the workshop is being organized to increase the intrinsic value of these data, information, and knowledge by integrating them into an interactive database which downstream users can access and use to develop response strategies to profound global changes.

Themes

- Estimating magnitudes and uncertainties in GHG emissions, aerosols, and land use and cover change in Southeast Asia.
- Integrating regional inventories of GHG emissions and trends of land use change.

- Using high resolution satellite and GIS datasets for regional estimates of land use/cover change and the regional emission of GHG.
- Integrating and assessing effects and impacts of LUCC-driven GHG/aerosol loading in the region.
- Predicting emission rates of GHG from future land use/cover change.
- Developing metadata directories from existing scientific information.

Expected Products

- Methodology and techniques for integration of data, information, and knowledge on LUCC, GHG, and aerosols including the possibility of using high resolution and GIS Integrated Assessment Models.
- Integrated and interactive databases on, GHG, and aerosols.
- Metadata directory of existing databases on land use and land cover change, GHG, and aerosols.
- Future science program for quantitative assessment of impacts of land use and land cover change on GHG emission, aerosols, and other atmospheric species; and management options to reduce GHG emission in relation to predicted land use and land cover changes.
- Publications in the form of a printed report; dedicated peer-reviewed special edition of a regional journal; and a CD-ROM that contains data and syntheses from the at-hand research in SARCS as well as other partners, such as ALGAS, U.S. Country Study Program, etc.

Sponsors

Southeast Asia Regional Committee for START
IGBP Land Use and Cover Change (LUCC) Core Project
IGBP International Global Atmospheric Chemistry (IGAC) Core Project
IGBP National Committee, China-Taipei

Further Information

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Workshop on Inverse Modeling of Global Biogeochemical Cycles
Heraklion, Crete
March 16-20, 1998

Inverse methods are crucial to determine from atmospheric concentration measurements the location and magnitude of sources and sinks of chemically and radiatively important atmospheric trace gases, such as carbon dioxide, methane, nitrous oxide, carbon monoxide and ozone. These techniques are still relatively new in the field of modeling global biogeochemical cycles and atmospheric chemistry, but will become even more important in the near future, when denser observational networks and more data from satellite platforms will become available.

This planned five day workshop is designed to foster expertise in inverse techniques by teaching young scientists about the mathematics of inverse problems and the issues of *a priori* constraints. The format of the workshop consists of a series of invited expert lectures combined with practical problem-solving exercises.

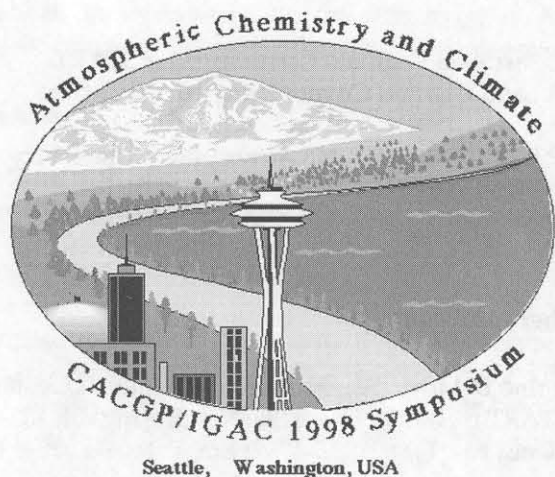
The workshop is supported jointly by IGAC's Global Integrated Modeling (GIM) Activity and the Global Analysis, Interpretation and Modeling (GAIM) Task Force of the IGBP. Additional support has been sought from the European program of Training and Mobility of Researchers.

The anticipated audience is young researchers at an advanced Ph.D. or early postdoctoral level. The number of participants is limited to about 35 in order to provide a fruitful teaching environment. In addition, the workshop is open (without financial support) to a limited number of established scientists who would like to profit from the expert lectures for their own research.

Applications for participation at the workshop should be sent to either Dana Hartley (e-mail: hartley@eas.gatech.edu, U.S. scientists) or Martin Heimann (e-mail: martin.heimann@dkrz.de, European and other non-U.S. scientists). Applications for financial support should include CV, brief research description and two letters of recommendation. The deadline for applications is December 31, 1997.

Additional information on the workshop may be found on the web-page: <http://www.gatech.edu/gsc/inverse/overall.web.html>

Scientific organization: Martin Heimann (Max-Planck-Institut für Meteorologie, Hamburg, Germany, e-mail: martin.heimann@dkrz.de), Dana Hartley (Earth and Atmospheric Sciences, Georgia Institute of Technology, Atlanta, GA, U.S.A, e-mail: hartley@eas.gatech.edu), and Prasad Kasibhatla (A333 Nicholas School of the Environment, Duke University, Durham, NC, U.S.A, e-mail: psk9@duke.edu).



Ninth Symposium of the IAMAS Commission on
Atmospheric Chemistry & Global Pollution (CACGP)
and

Fifth Scientific Conference of the International Global
Atmospheric Chemistry Project (IGAC)
Seattle, Washington, USA
19-25 August 1998

For further information:

<http://saga.pmel.noaa.gov/cacgp98/> or Dr. Patricia Quinn, NOAA/PMEL/OCRD, Building 3, 7600 Sand Point Way NE, Seattle, WA 98115, USA
Fax: (+1-206) 526-6744, Email: quinn@pmel.noaa.gov

Important Note:

The 1998 American Meteorological Society Conference on Cloud Physics is currently planned for the Seattle area from August 17-21, 1998. The conference is timed to partially overlap the CACGP-IGAC Symposium on Global Atmospheric Chemistry. Cloud and Precipitation chemistry sessions at the Cloud Physics Conference will be scheduled on 17-18 August so that scientists interested in these disciplines can attend both the AMS and CACGP-IGAC conferences. Information about the Cloud Physics conference can be obtained from the Program Chairman, Dr. Bob Rauber (r-rauber@uiuc.edu), or by accessing the conference web site at:

http://www.atmos.uiuc.edu/cloud_phys_conf/

1998 WMO-IGAC International Cloud Chemistry Modeling Meeting

It is well recognized that the accurate simulation of the physical and chemical processes in clouds is critical to our understanding and representation of atmospheric chemistry and global climate. The 1996 WMO Cloud Modeling Workshop in Clermont-Ferrand, France, included a focus on cloud chemistry for the first time. A full report on the details of the workshop and its findings will be available from WMO in 1997. In short, the cloud chemistry group was successful in developing the process and found it to be worth continuing. Consequently, a follow-up meeting of the cloud chemistry group will be held in late September or early October of 1998 in Nova Scotia, Canada. The meeting will be conducted in sequence with the WCRP-IGAC Workshop on Large-Scale Models Simulating Atmospheric Sulfate Aerosols Intercomparison Workshop (see accompanying announcement). Details of the large-scale model workshop can be obtained from Len Barrie at len.barrie@ec.gc.ca. The objectives of the cloud chemistry meeting are as follows:

- To bring together cloud chemistry modelers and data collectors in a common forum
- To examine model intercomparisons based on common observational data inputs, and perform comparisons of simulations with observations
- To highlight current cloud chemistry issues to aid in the direction of future field measurements and modeling efforts

MODELING SCALES

The WMO cloud modeling workshops have traditionally focused on simulations of the mesoscale and smaller, and the 1998 meeting will focus on regional scales down to the microscale. It is hoped that this focus will provide a good complement to the Large-Scale Model Intercomparison Workshop that will address issues related to aerosols.

DATASETS

The datasets to be used were obtained during the 1993 intensive measurement period of the North Atlantic Regional Experiment (NARE). Many of the datasets are described in the NARE special section of the *Journal of Geophysical Research - Atmospheres* (101(D22), Dec., 1996). Two cases will be considered for intercomparison. Case One will deal with the influence of cloud-top reflectance on photochemistry above low marine stratus. Data from the NCAR King Air are used for initialization, and the Canadian IAR Twin Otter data are used to examine the evolution of O_3 and H_2O_2 . Case Two will examine the role of S(IV) oxidation in the low stratus on changes in the size distribution of the atmospheric aerosol. Airborne and ground-based data collected just prior to the development of low marine stratus are used for initialization. Data from the same platforms collected at later times will be used to examine the evolution. The initialization and evolution data for both cases, in addition to the complete Twin Otter dataset, are available at <http://www.on.doe.ca/armph/NARE/NARE.html> under WMO9854.

To participate or for further information, please contact either Andrea Flossman (flossman@opgc.univbpclermont.fr) or Richard Leaitch (leaitch@armph3.tor.ec.gc.ca).

Please return to the IGAC Core Project Office by mail or email (erobbins@mit.edu)

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1998 WCRP-IGAC Workshop on: A Comparison of the Performance of Large Scale Models in Simulating Atmospheric Sulfate Aerosols

Three-dimensional models of atmospheric trace constituents currently abound since they are important tools in understanding climate, stratospheric ozone depletion, tropospheric oxidants and acidification of ecosystems. An indication of the level of interest in this area is that 13 groups ran the CFC-11 test problem for the WCRP Scientific Symposium on Global Tracer Transport Models in 1990 which was the first workshop in a series. The second workshop in 1993 on Parameterization of Sub-grid Scale Tracer Transport involved 22 models running a ^{222}Rn experiment. In 1995, 15 models were run for a third workshop on the Transport and Scavenging of Trace Constituents by Clouds in Global Atmospheric Models. Current interest in the role of aerosols and in climate makes the processes of chemical transformation in clear air and in clouds, precipitation scavenging, dry deposition and stratospheric-tropospheric exchange especially important. Sulfates are generally believed to be major aerosol constituents that are radiatively important. Significant quantitative uncertainties persist in our understanding of their distribution and of the factors that control it.

The community of modelers currently interested in these processes are divisible roughly into two groups, namely, modelers who are attempting to include aerosols as interactive constituents in climate models and atmospheric chemical transport modelers who are trying to understand the chemical formation, physical transformation and scavenging pathways of these constituents using models driven off-line by climate-model-generated or observed winds (analyzed winds). Although there are exceptions, the former move in WCRP Working Group on Numerical Experimentation (WGNE) circles while the latter are generally concentrated in the Global Integration and Modeling (GIM) Activity of IGAC. In both modeling approaches, the processes of trace constituent transport, transformation and removal are parameterized with varying degrees of sophistication. There is a need to bring the two groups together to utilize the expertise of each to the advantage of all.

It is proposed that a joint WGNE-GIM workshop of about 40 people be held in late September or early October of 1998 in Nova Scotia, Canada. The meeting will be conducted in sequence with the 1998 WMO-IGAC International Cloud Chemistry Modeling Meeting. The objectives are as follows:

1. Compare model-predicted distributions of atmospheric sulfate aerosols and associated precursors (e.g. DMS, SO_2) with regional sulfur budgets, observations at ground level and in the vertical.
2. To understand which processes are contributing to differences in the models and observations (i.e., boundary layer mixing, vertical convection, chemical/physical transformation and precipitation scavenging).

To participate or for further information, please contact the chair of the organizing group L.A. Barrie (len.barrie@ec.gc.ca).



IGACtivities Newsletter

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Personnel Notes

Contributed by A. Pszenny, IGAC Core Project Office, USA

The IGAC Scientific Steering Committee

A significant change in the membership of the IGAC Scientific Steering Committee (SSC) occurred at the beginning of 1997 when the last 6 inaugural members completed their terms of service. While their energy, wisdom, and good humor will surely be missed, we are not "losing" them entirely. Hajime Akimoto will stay on as Convener of IGAC's *East Asia - North Pacific Regional Experiment* (APARE) Activity for another year or two. Pamela Matson and Henning Rodhe became members of the Scientific Committee for the IGBP (SC-IGBP) for three years as of January 1st, and Paul Crutzen has been appointed as a Vice-Chair of that body effective January 1, 1998. Ian Galbally will be assisting the SSC and Conveners in effecting a proposed merger of several of IGAC's Activities concerning trace gas emissions from terrestrial systems.

Succeeding these people on the IGAC SSC are six new members: Jariya Boonjawat of Thailand, Paul Fraser of Australia, Yutaka Kondo of Japan, Shyam Lal of India, Mary Scholes of South Africa, and Neil Trivett of Canada. The full 1997 membership of the SSC is:

Guy Brasseur (USA; Chair)

Jariya Boonjawat (Thailand; Vice-Chair)

Patricia Matrai (USA; Vice-Chair)

Stuart Penkett (UK; Vice-Chair)

Paulo Artaxo (Brazil)
Ralf Conrad (Germany)
Robert J. Delmas (France)
Paul Fraser (Australia)
Jost Heintzenberg (Germany)
Peter Hobbs (USA)
Barry Huebert (USA)
Vyacheslav Khattatov (Russia)
Yutaka Kondo (Japan)

Shyam Lal (India)
John Miller (Switzerland;
WMO Liaison member)
Heinz-Ulrich Neue (Germany)
Mary Scholes (South Africa)
Sjaak Slanina (Netherlands;
IUPAC Liaison member)
Neil Trivett (Canada)
Wang Mingxing (China-Beijing)

The Scientific Committee for the IGBP

Additional important changes in the leadership of the IGBP are forthcoming. Current SC-IGBP Chair Peter Liss will be succeeded on January 1, 1998, by Berrien Moore III, who has been Chair of IGBP's Global Analysis, Interpretation and Modeling (GAIM) Task Force since its initiation several years ago. Also effective January 1st, Will Steffen, now the Executive Officer of IGBP's Global Change and Terrestrial Ecosystems (GCTE) Core Project, will move to Stockholm and succeed Chris Rapley as Executive Director of IGBP.