IGACtivities NewsLetter

of the International Global Atmospheric Chemistry Project

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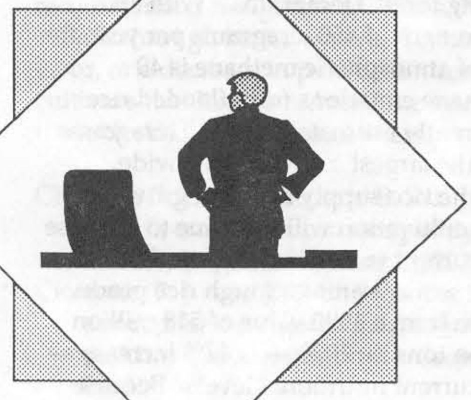
In this issue



A Note From the IGAC Chair

It is my pleasure to introduce the first issue of the IGAC*tivities* Newsletter which will be published regularly by the Core Project Office (CPO) in the future. IGAC, with its third scientific conference just a few months away, is in an exciting and productive phase. But like any large endeavor of this type it has its problems as well as its successes. The purpose of the Newsletter is to provide, in a colloquial form, both timely communication of scientific events and a forum for discussion of key issues for the international atmospheric chemistry community. The Newsletter also provides a mechanism for informing scientists in related fields, and people involved in the funding of IGAC*tivities*, about current progress (and problems) in atmospheric chemistry. You will notice in this issue we have sections devoted to special features, news, awards, and events. These resulted from solicitations by the CPO for contributions from some Activity Conveners. Remember, this is your Newsletter and it will have greatest usefulness and impact if you actively participate by contributing to future issues. I hope you enjoy this first issue, and the editors, Alex Pszenny and Elaine Robbins, welcome your suggestions and contributions. Finally, I am pleased to tell you that the CPO has also launched a homepage for IGAC on the World Wide Web. The URL is *http://web.mit.edu/igac/www/*.

Ronald G. Prinn

Science Feature: Mitigation of Methane Emissions from Irrigated Rice Agriculture

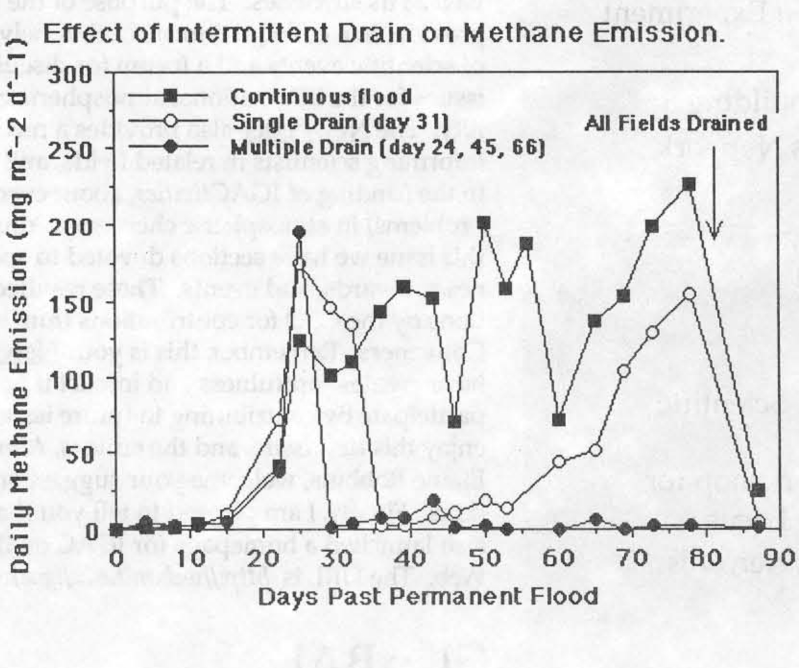
Cotributed by R.L. Sass, Rice University, Houston, Texas, USA

The total annual global source strength of atmospheric methane, an important greenhouse gas, is estimated to be 500 teragrams, with anthropogenic sources accounting for 340 teragrams. With an estimated sink strength of 460 teragrams per year, the annual increase of atmospheric methane is 40 teragrams. Methane emissions from flooded rice cultivation is currently estimated to be 60 teragrams per year, among the largest sources worldwide.

To meet the rice supply needs of growing populations, rice cultivation will continue to increase at or beyond its current rate. It is estimated, for example, that the world's annual rough rice production must increase from a 1990 value of 518 million tons to 761 million tons by 2020 — a 47% increase — just to maintain current nutritional levels. Because arable land is highly limited in major rice growing areas, increased production has to be achieved mainly by intensifying cropping (i.e., two or three crops per year) rather than expanding the area of rice cultivation. Irrigated rice will continue to dominate production. Irrigated rice land now comprises about half the total harvested area but contributes more than two-thirds of the total grain production. With present agronomic practices, this will lead to increased methane emissions.

Because rice agriculture is one of the few sources of methane emission where management of the system is possible, it has become a critical focus of mitigation efforts. However because rice is also the world's most important wetland crop and the primary calorie source of a large fraction of the world's population, mitigation efforts must be based on sound agricultural practices as well as good scientific judgment.

A primary mitigation "switch" of the production and emission of methane is the presence of oxygen in the rhizosphere environment. Removal of oxygen from the rhizosphere is normally through consumption by soil bacteria. The presence of the flood water impedes the diffusion of oxygen from the atmosphere into the soil and thus keeps it anoxic. It has been observed by Sass et al. (1992) that a single drain of the flood water at the end of the vegetative stage allowed the soil to be reoxidized, reducing the seasonal methane emission by nearly 50%. Repeated drains every three or four weeks throughout the rice growing season, reduced seasonal methane emission by 88% without affecting grain yield (see figure). Yage et al. (1994) observed methane emission reductions of approximately 50% in intermittently drained plots when compared with continuously flooded Japanese rice paddies.



An important contributor to variations in observed methane emissions and a strong candidate for mitigation is the use of different rice cultivars. There are currently some 80,000 different rice cultivars available through the germplasm bank at the International Rice Research Institute in the Philippines, and others are being sought. Most of these were developed for specific areas of the world and many are in current use. Yet, very few methane emission studies have considered cultivar differences. Methane emissions from eight different cultivars grown under similar conditions near New Delhi, India differed by as much as an order of magnitude (Parashar et al., 1991). A study of five rice cultivars in irrigated fields near Beijing, China, indicated that methane emission during the tilling-flowering stage varied by a factor of two (Erda, 1993). A preliminary study by Sass and Fisher (private communication) using ten cultivars showed seasonal methane emissions ranging from 18.2 to 41.0 g m^{-2}. All three studies show a significant variation in methane emission that is solely dependent on cultivar choice. Cultivar choice by individual farmers could thus greatly influence regional and global estimates of methane emission from rice fields.

The wide variation of traits and related emission rates among cultivars opens the possibility for the choice of existing cultivars and the breeding of new cultivars as a method for mitigation of methane emission. However, the relationships between different cultivar characteristics and methane emission have yet to be elucidated. Some cultivars may have more or less efficient conduits for the removal of methane from the soil through the rice plant, others may deposit different amounts of organic matter in the soil during the growing season or may differ in the ability to transfer oxygen to the rhizosphere, thus altering the redox potential of the soil system or modifying the bacterial response of the rhizosphere. In other cultivars, differential allocation of translocatable carbon may even promote higher grain yield in preference to root processes and eventual methane production and emission.

The reported effects of different mineral fertilizer applications on methane emission are inconsistent. Schütz et al. (1989) concluded that the type and method of application strongly influenced methane emission rates. Lindau et al. (1991) observed increased methane emissions with increased urea application. Cicerone and Shetter (1981) reported large increases in emission after fertilization with ammonium sulfate while other studies (Schütz et al., 1989; Yagi and Minami, 1990) show a decrease. Lindau et al. (1990a, 1990b, 1991, 1993) found that methane emission rates are affected by the method of fertilizer application (Schütz et al., 1989; Kimura et al., 1992). Many other studies agree that the application of organic matter to rice paddies strongly increases methane emission rates over that from mineral fertilization. Emission rates are dependent on amount, kind, and prior treatment of the organic components (Sass et al., 1991; Chen et al., 1993; Lindau and Bollich, 1993; Wassmann et al., 1993; Yagi and Minami, 1993; Neue et al., 1994).

Current research efforts clearly indicate that realizable options are available to mitigate methane emissions from flooded rice fields. Successful implementation of these options will depend upon the collective acceptance by the rice farmers of Asia and the rest of the world. In order for that to happen, research results must be able to demonstrate that: (1) grain yield will not be decreased and may be increased by a particular mitigation practice, (2) that by adopting recommended mitigation practices the farmer will benefit through better water utilization, reduction of labor, or a decrease in production costs, and (3) the rice cultivars that lead to reduced methane emission are those desired by local consumers.

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RICE Proposes CH_4 Flux Measurement Standardization Experiment

Contributed by R. L. Sass, Rice University, Houston, Texas, USA

As a result of planning meetings held at the International Rice Research Institute, Los Baños, Philippines on March 14-18, 1994 and Tsukuba, Japan on March 24-26, 1994 , IGAC's *Rice Cultivation and Trace Gas Exchange* (RICE) Activity Coordinating Committee proposes a retrospective analysis of the role of rice production on increasing atmospheric concentrations of methane and other trace gases and to provide direction, integration, and coordination of field research activities leading to a quantitative assessment of rice fields as a global source of atmospheric methane.

In order to carry out this proposal, the RICE Committee recommends a large global campaign to measure methane (and possibly N_2O) emissions from rice agriculture using a common standardized experimental approach. The RICE Committee invites all active research groups to participate in this campaign as part of their ongoing measurement programs. The campaign will apply only to one field trial and should not be thought of as replacing the specific measurement programs of participating research groups. The global measuring campaign does not commit a research group to a new program, but is meant as a supplementary measurement to allow for intercomparison of the ongoing research results of all participating groups.

This campaign should have a latitudinal approach as well as a country approach. Over 200 laboratories in all major rice growing regions of the world have been invited to participate. A detailed protocol, contained in a pamphlet entitled "Global Measurement Standardization of Methane Emissions from Irrigated Rice Cultivation" has been sent to each of these laboratories. Laboratories agreeing to participate are encouraged to conduct certain standardized emission measurements companion to their own individual experiments in order to obtain control flux measurements that will insure the intercomparability and intercalibration of extended data sets that may be generated.

The data from this program will be used to develop predictive process-level models of methane emissions and to link remotely sensed data on variables such as biomass, leaf area index, temperature and water depth to methane emission rates. Both the predicted values of methane emission and the values derived from remote sensing can then be incorporated into geographic information systems (GIS) to provide predictions of the effects of changes in rice cultivation on trace gas production, and to extrapolate methane emissions from core sites to regional and global scales.

It is anticipated from previous experimental studies that a data set of companion measurements will need to be taken along with seasonal methane flux measurements to accomplish these goals. The proposed standardization program consists of a specified experimental plan for seasonal flux measurements along with specific accompanying data on location and climate, soil, water management, plant characteristics, fertilizer treatment, and a detailed cropping calendar. These data are considered to represent the minimum data set needed to characterize seasonal emission measurements for inclusion in a global survey aimed at resulting in a global assessment of atmospheric methane source values from irrigated rice fields.

The project should be comprised of a complete year of field data collection. Publication of the results will be the responsibility of individual research groups. The collective data set will be standardized for general use and archived for general distribution on the internet by the U.S. Trace Gas Network (TRAGNET), a part of the worldwide program being established under the auspices of IGAC's *Trace Gas Exchange: Mid-Latitude Ecosystems and Atmosphere* (TRAGEX) Activity (see following article).

For further information on the RICE standardization program contact R.L. Sass: Rice University, Ecology and Evolutionary Bilology Dept., P.O. Box 1892 Houston, TX 77251, USA (sass@rice.edu) or H.-U. Neue : International Rice Research Institute, Division of Soil and Water Sciences, P.O. Box 933, 1099 Manila, PHILIPPINES (h.neue@cgnet.com).

IN THE NEWS

In September, 1992 a scientific and organizational planning workshop was held at Pingree Park, Colorado to develop a program to integrate sites across North America where fluxes of CO_2, CH_4 and N_2O and other trace gases are being made. Concomitantly, the development and implementation of quantitative flux models at several geographic scales was planned. This Trace Gas Network (TRAGNET) is designed to fulfill the U.S. contribution to the worldwide program being established under the auspices of IGAC. The project relates particularly to IGAC Activity 5.2 (TRAGEX), which is specifically aimed at characterizing trace gas fluxes in the mid-latitudes. TRAGNET will, however, utilize data from both more nothern and more southern locations as well. In September, 1994, the U.S. National Science Foundation provided funds to permit establishment of a TRAGNET activity. Under this program, TRAGNET will establish a database and model analyses to be used in determining general relationships of trace gas exchange across broad environmental gradients in climate, atmospheric deposition of N, and soils. The Network includes, as a core, many LTER (Long-Term Ecological Research) sites and other long-term research sites where trace gas fluxes are being measured, and locations where trace gas flux model development is being conducted. Establishment of models and data bases with which to use the models is being initiated at the Natural Resource Ecology Laboratory at Colorado State University as a task of TRAGNET. Persons conducting trace gas flux measurements or modeling of trace gas fluxes are encouraged to participate in TRAGNET.

For further information on TRAGNET contact:

Arvin Mosier: U.S. Department of Agriculture, ARS. P.O. Box E, Fort Collins, CO 80522-0470, USA (amosier@lamar.colostate.edu) or,

Dennis Ojima: Colorado State University, Natural Resource Ecology Laboratory, Fort Collins, CO 80523, USA (dennis@nrel.colostate.edu).

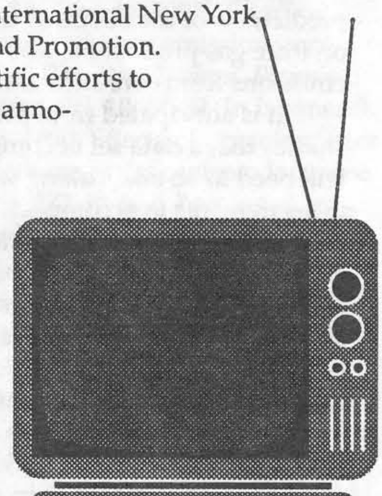
Awards

Global Change Television Series Receives New York Festivals Award

The NASA Langley Research Center, Old Dominion University, and the Virginia Space Grant Consortium received medalist honors for the television series 'Mission EarthBound' at the International New York Festivals Awards Competition for Non-broadcast Media and Television Programs and Promotion.

'Mission EarthBound' is a six-part teleconference-conference detailing scientific efforts to better understand human-induced changes in the composition and chemistry of the atmosphere and on global climate:

1. Preview the Mission EarthBound' series.
2. The cosmic perspective: formation of the Earth, the atmosphere, and life.
3. Atmospheric ozone: what is it and what is happening to it?
4. The climate system: one of the most complex systems in the world.
5. Greenhouse gases and climate change.
6. Challenges and solutions to global atmospheric problems.



The scientific script of 'Mission EarthBound' was written by Dr. Joel Levine of NASA's Langley Research Center, who served as on-camera host for the series. The television series featured slides and video-tapes of biomass burning taken during the Southern African Fire-Atmosphere Research Initiative (SAFARI), conducted as part of the IGAC Biomass Burning Experiment (BIBEX)Activity.

Copies of the 'Mission EarthBound' series in VHS format and the Teacher's Guide can be obtained from Mark Pine, Mission to Planet Earth Program, NASA Headquarters, Washington DC 20546-0001, USA Fax: (+1-202) 358-2891.

IGAC tivities NewsLetter

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Events

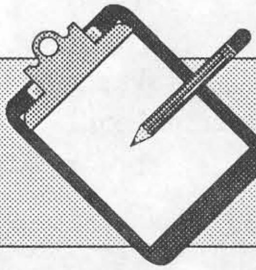
WMO/IGAC Conference on the Measurement and Assessment of Atmospheric Composition Change

9-13 October 1995, Beijing, China

Under the auspices of the World Meteorological Organization and the International Global Atmospheric Chemistry Project, and hosted by the China Meteorological Administration, this scientific and technical conference has been called to review the progress made under the Global Atmosphere Watch (GAW) and IGAC Activities to measure and to assess the impacts of world-wide change of atmospheric composition and its relation to the climate and the environment.

The conference, one of a series held every four years by the WMO, and the third annual conference of IGAC, will provide an international forum for the discussion of global issues, especially those relating to the role of GAW and IGAC measurements of global and regional importance. Special reports from GAW stations are encouraged. Furthermore, assessments of major atmospheric environmental issues will be presented and will include research results from both long-term measurement programs and process-oriented studies on related topics. From the deliberations of this conference, it is expected that a clearer picture of both the present state of our knowledge concerning the global atmosphere environment and the future research directions of IGAC and GAW will emerge.

For complete information contact: John Miller, Environment Division, AREP, World Meteorological Organization, 41 Ave. Giuseppe Motta, CH-1211, Geneva 2 Switzerland. Fax: (+41-22) 740 0984, E-mail: john-milton.miller@itu.ch



WORKSHOP ANNOUNCEMENT

Atmospheric Aerosols: A New IGAC Focus

A workshop entitled: "Atmospheric Aerosols: A New IGAC Focus" will be held in Boulder, Colorado, from 7:30-10:00 p.m. on the evenings of July 12 and 13, 1995, as part of the XXI General Assembly of the IUGG (Workshop MW7). The workshop will be held in the Engineering Building, Room CR 030.

This workshop, which is open to all, will provide the first opportunity to brief the international community on the recent merger of the International Global Aerosol Program (IGAP) with the International Global Atmospheric Chemistry (IGAC) Core Project of the International Geosphere-Biosphere Program (IGBP). An IGAC/IGAP Merger Panel has defined the broad scientific objectives and the organizational structure of the new IGAC *Focus on Atmospheric Aerosols*. The Merger Panel now invites the international community to become involved in the detailed planning and implementation of the new Focus.

If you are interested in the new *Focus on Atmospheric Aerosols* but cannot attend this Workshop, written expressions of interest may be sent to Dr. Alex Pszenny, IGAC Core Project Officer, Building 24-409, Massachusetts Institute of Technology, Cambridge, MA, 02139-4307, USA; Fax: (+1-617) 253-9886; E-mail: pszenny@mit.edu. From these communications, the Workshop attendees, and current IGAC and IGAP mailing lists, a new mailing list will be created for reports of IGAC aerosol research activities.