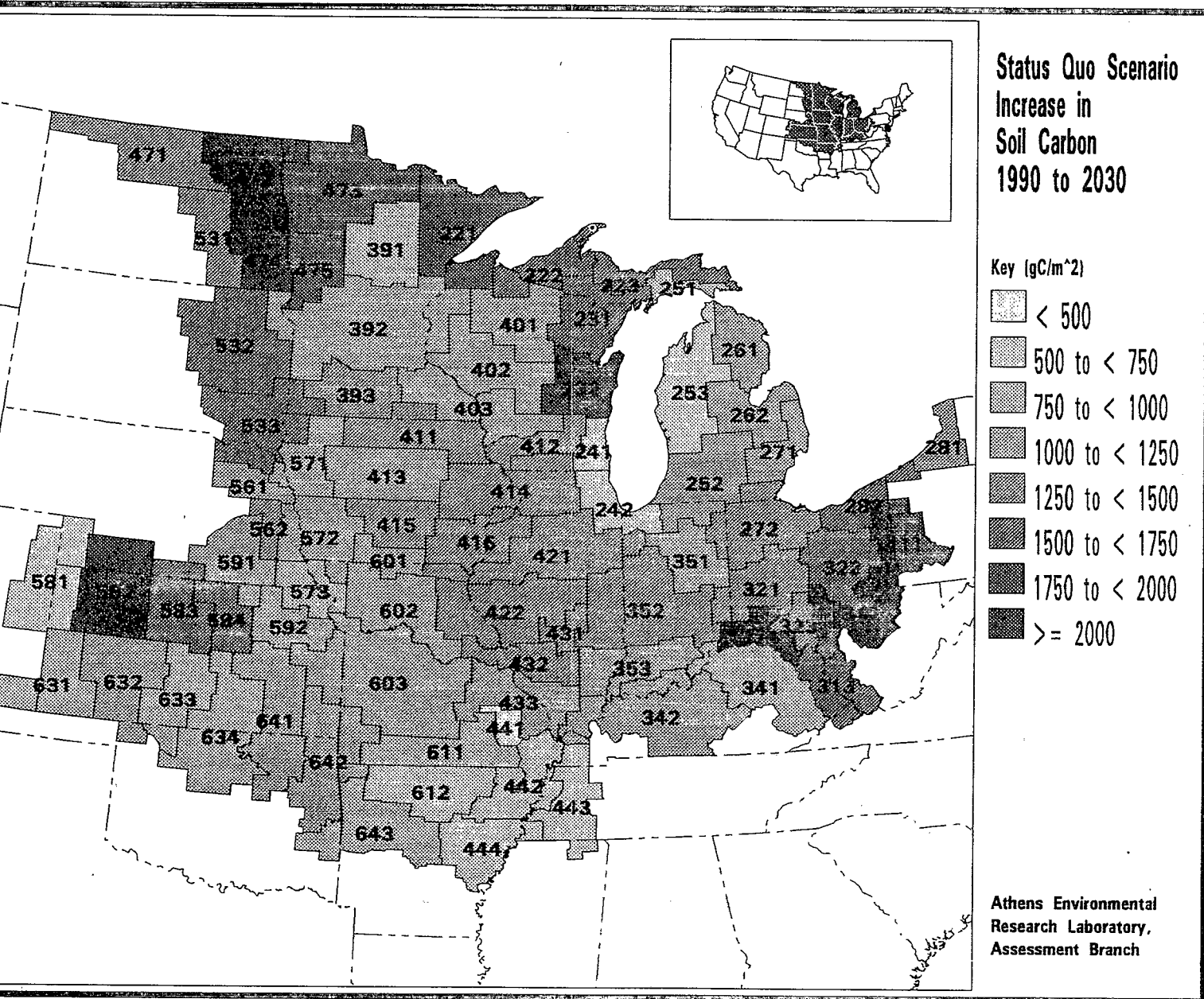




# Environmental Research Laboratory - Athens, GA

## 1992 Highlights

## DOCUMENT COLLECTION



**Cover Illustration:**

*Computer modeling and Geographical Information Systems support investigations of agriculture's capacity to serve as a sink or a source for greenhouse gases. One study from the Lab's Global Change Research Program indicates that carbon is accumulating in the agricultural soils of the central United States. The carbon that accumulates in these soils was recently atmospheric carbon dioxide, a greenhouse gas.*

The U.S. Environmental Protection Agency's Environmental Research Laboratory at Athens, Georgia, conducts and manages basic and applied research to predict, assess, and reduce human and environmental exposures and risks from pollutants in freshwater, marine, and terrestrial ecosystems and the emission of greenhouse gases to the atmosphere.

Athens researchers identify and characterize the natural biological and chemical processes in soils, surface waters, and sediments that affect the environmental fate of toxic substances, such as solvents, pesticides, or metals. The results are applied in state-of-the-art multimedia transport models for predicting and assessing exposures and managing environmental pollution problems. A second emphasis involves the development of ecological risk assessment methods to evaluate pollutant and other stressor on ecosystems such as the Great Lakes, Chesapeake Bay, and large agricultural areas.

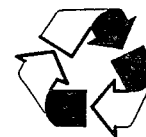
Lab-developed fate and process data and assessment techniques support EPA's environmental management, regulation, and enforcement activities. Major research areas include global climate change, stratospheric ozone depletion, ecological risk assessment, sediment quality evaluation, computational chemistry, identification of complex organic pollutants, nonpoint source pollution management, agroecosystem monitoring and assessment program, multimedia nitrogen impacts, bioremediation, chemical remediation, and wellhead protection. The Center for Exposure Assessment Modeling distributes models and documentation to environmental managers throughout the world by mail and via electronic bulletin board.

*Rosemarie C. Russo, Ph.D., Director*

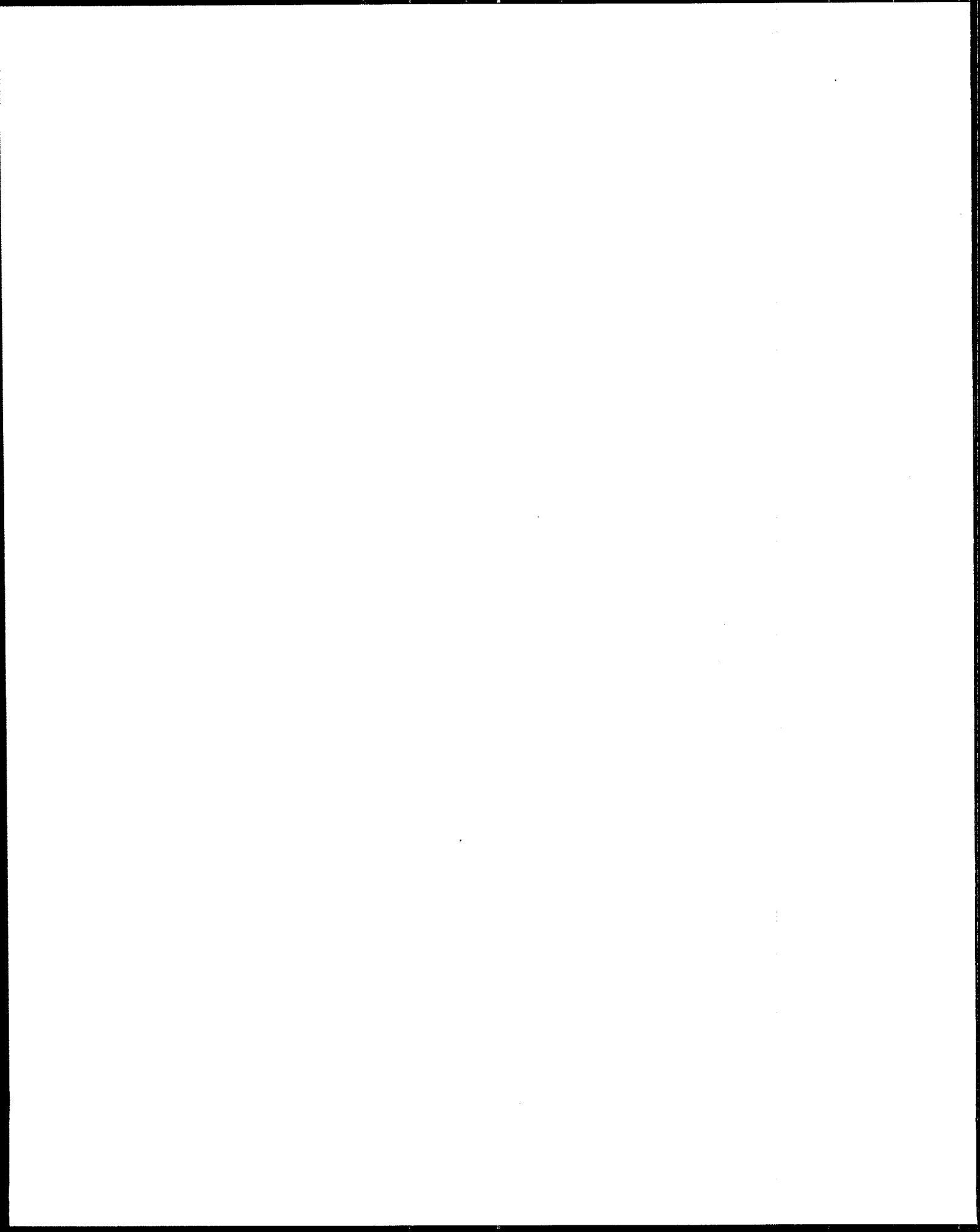
*Robert C. Ryans, Technical Information Manager*

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*The Office of Research and Development (ORD) conducts an integrated program of scientific research and development on the sources, transport and fate processes, monitoring, control, and the assessment of risk and effects of environmental pollutants. These activities are implemented through its headquarters, offices, technical support offices, and twelve research laboratories distributed across the country. The research focuses on key scientific and technical issues to generate knowledge supporting sound decisions today, and to anticipate the complex challenges of tomorrow. With a strong and forward-looking research program, less expensive, more effective solutions can be pursued and irreversible damage to the environment can be prevented.*



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## Program Highlights

### Atomic Force Microscopy

Laboratory chemists are applying the new technology of atomic force microscopy in studies of the processes of oxidation, reduction, precipitation, and dissolution of metal ions. Atomic force microscopy provides scientists, for the first time, with the capability to analyze the structure, morphology, and chemical reactivity of environmental surfaces at the atomic level of resolution. It is these environmental surfaces—mineral, organic and microbial in nature—that play a large role in controlling the fate of organic and inorganic pollutants in the environment.

Initial work involves confirming surface structures of silicates and humic and fulvic acids, including observation of features important to metal binding processes. Results of these examinations of environmental processes by atomic force microscopy will permit the development of improved models for predicting the behavior of pollutants in water and soil environments.

[G. Bailey, 706-546-3307]

### New Method for Detecting Azo Dyes

Research to characterize the structures of sulfonated azo dyes resulted in the discovery of a potential means of identifying these compounds in complex structures in ambient environments. The discovery was made through the application of secondary ion mass spectrometry/tandem mass spectrometry. These dyes comprise more than half of the 57 million pounds of textile dyes used annually in the United States. Because laboratory studies have shown that these dyes and their aromatic amine metabolites, resulting from microbial transformation in ambient environments, cause cancer in laboratory test animals, it is important to be able to identify and measure the dyes in aqueous and solid wastes.

Although the study was designed to elucidate structures of the dyes, an important by-product was the detection of many fragment ions. Selective ionization, therefore, shows promise

as a means of identifying and measuring azo dyes and other chemicals in the complex mixtures in which they are normally found in ambient environments.

[S. Richardson, 706-546-3199]

### Biosystems Technology Development

A major focus of EPA's Biosystems Technology Development Program has been the investigation of bioremediation technologies for the *in situ* treatment of hazardous waste. On-going research by Athens scientists and others was presented at a meeting in May. Research results will provide the basis for establishing effective *in situ* bioremediation strategies for treatment of single and mixed-chemical wastes often encountered in waste sites and for developing scientifically sound strategies for treatment at Superfund sites.

The May forum included discussions of research projects on bioremediation of soils and sediments contaminated with aromatic amines; characterization of microorganisms, microbial consortia, and microbial processes associated with reductive dechlorination; decontamination of PCB-contaminated sediments; and effects of metals on the anaerobic dechlorination of halogenated phenols.

[J. Rogers, 706-546-3592]

### Predicting Organics Fate with Infrared PRC's

A new approach that applies infrared-spectroscopy-based property reactivity coefficients was developed for predicting the environmental fate of organic chemicals. The potential for the new system, which is based on Fourier transforms of infrared spectra, for predicting hydrolysis rate constants for broad structural classes has been demonstrated with 41 carboxylic acid esters exhibiting a wide range of structures and reactivities.

Methods for predicting the physical and chemical constants, such as hydrolysis rates,

required for exposure assessments, are important to the Agency as it evaluates the thousands of chemicals for which exposure and risk assessments are required. Laboratory measurements for these chemicals are prohibitively slow and expensive to perform.

[T. Collette, 706-546-3525]

## EPA's Earth Systems Modeling Program

The Athens Laboratory, in cooperation with the National Center for Atmospheric Research and the Lawrence Livermore National Laboratory, is implementing a new research program on earth systems modeling as part of the Global Climate Change Research Program.

The goal is the systematic development of an earth systems model that is modular in design, enables the exploitation and further development of terrestrial biospheric modeling components and tropospheric chemistry relationships, and produces models and modeling experiments that demonstrate the feasibility of fully coupled, three-dimensional models of earth systems.

Major elements of the earth systems model framework will include atmospheric and ocean circulation and biogeochemistry models, cryospheric models, and biophysical representations of the terrestrial system including the hydrologic cycle.

[L. Mulkey, 706-546-3129]

## SAFARI Study of Greenhouse Gas Flux

Three ERL-Athens chemists studied the effects of savanna burning on soil fluxes of trace carbon gases (carbon dioxide, methane, and carbon monoxide) as part of the Southern African Fire-Atmosphere Research Initiative (SAFARI) in September. Scientists from 12 nations participated in the month-long project sponsored by the International Geosphere-Biosphere Program in Kruger National Park, South Africa.

SAFARI involved a wide range of activities, including analysis of satellite-generated data, collection of air emissions using aircraft, and determination of effects of biomass burning on soil fluxes of greenhouse gases. The ERL-

Athens studies were conducted in collaboration with National Aeronautics and Space Administration scientists and with a team of terrestrial ecologists from public and private environmental organizations in South Africa.

Preliminary analyses of results indicate that both added moisture and fire greatly enhance biogenic emissions of carbon dioxide and nitric oxide from the soils, that a methane sink is not active in any of the soils before or after burning or up to 2 weeks after addition of water, and that no nitrous oxide emissions occurred. Post-SAFARI studies will involve the determination of polycyclic aromatic hydrocarbons and graphitic carbon in burned biomass residue collected from the soil surface.

The PAH data will be useful in studies of fire effects. These studies will be conducted in collaboration with scientists at the Max Planck Institut für Chemie in Mainz, Germany.

[R. Zepp, 706-546-3428]

## Comprehensive Exposure Assessment for Agrichemicals

The Lab launched a comprehensive exposure assessment modeling study on the effects of agricultural chemicals in surface water and groundwater systems and on adjacent terrestrial riparian zones. The project is part of EPA's Midwest Agrichemical Surface/Subsurface Transport and Effects Research (MASTER) Program that combines EPA and U.S. Department of Agriculture research requirements in conducting watershed-scale response analyses involving complex hydrogeological features.

The Walnut Creek Watershed near Ames, Iowa, is the study site. The modeling study uses several comprehensive watershed-scale tools for the chemical exposure and aquatic habitat assessment. HSPF models surface runoff, erosion and stream channel effects. 3DFEMWATER/3DLEWASTE simulates groundwater response. PRZM-2 integrates the field-scale effects. The models will evaluate the effects of agricultural production and agrichemicals on the ecological and geomorphological status of the watershed. The results of these evaluations will be used in the MASTER program to develop procedures for assessing pollutant and land management effects on the midwestern cornbelt and other large areas and for designing an ecologically

benign management strategy that will be implemented and demonstrated on the Walnut Creek site over the next 5 years.

[R. Swanik, 706-546-3128]

## Support for EPA's Corrective Action Rule

In response to a request by EPA's Office of Solid Waste (OSW) for assistance in implementing a Regulatory Impact Analysis (RIA), three ORD labs assembled a team of experts to provide information on ground water, surface water, and atmospheric modeling. The ORD team produced an organic and inorganic chemical database, developed specific recommendations for modeling in complex hydrogeological conditions, carried out complex case study analyses, tested and modified the computer model used in the RIA, and performed an uncertainty analysis.

The experts were from the ERL-Athens, the R.S. Kerr Environmental Research Laboratory-Ada, and the Atmospheric Research and Exposure Assessment Laboratory.

The RIA provides a national-scale estimate of the costs and benefits (that is, reduction in human and ecological risks) that would result in the implementation of OSW's proposed Corrective Action Rule.

The integrated multimedia modeling approach developed in this effort is being applied to other important Agency issues, such as the fate of lead in the environment and cross-media risk trading.

[D. Brown, 706-546-3546]

## EMAP Agroecosystem Study in North Carolina

The quality of irrigation water supplied by farm ponds and on-farm wells is being assessed in a pilot study in North Carolina. Under EPA's Environmental Monitoring and Assessment Program (EMAP), samples are analyzed for atrazine, carbofuran, aldicarb, and other selected pesticides (applied to crops such as tobacco, peanuts, corn, and cotton) and nitrates.

In addition, monitoring wells are installed in the Little Coharie Watershed in a statistically

random pattern. These wells will provide controlled, reliable ground water data on pesticides and nitrate that can be compared with data from existing on-farm wells. The research effort also will provide an opportunity to test groundwater threat models for predictive capability on a variety of scales.

[C. Smith, 706-546-3175]

## Chemical Characterization of Hazardous Waste Components

Lab scientists are developing chemical transformation pathway profiles for more than 200 chemicals under consideration in establishing the Office of Solid Waste's Hazardous Waste Identification Rule and determining whether specific waste components are most appropriately modeled using the finite- or infinite-source modeling methodologies. Profiles include determination of the processes by which each chemical will degrade or be transported, sediment-water distribution coefficients, and transformation rates for the listed chemicals (parent) and their transformation products (daughter) as well.

After analysis of theoretical considerations, which identify likely daughter products on the basis of chemical structure, the transformation rates and equilibrium constants are arrived at by considering measured values from the literature, applying computational chemistry methods, postulating values from chemical structure, and making laboratory measurements for parameters considered critical to the Rule's application for chemicals for which remaining levels of uncertainty are unacceptable.

Development of these profiles is possible only because of the knowledge gained in ERL-Athens' unique 20-year program in environmental chemical process research.

[W. Donaldson, 706-546-3183]

## Environmental Education Reaches Students, Teachers

The Lab's Environmental Science Education Program, established in 1991 and managed by Ms. Kate McDaniel, continued its outreach activities. Twenty teachers representing school districts from across Georgia attended an intensive, 8-day workshop entitled "Envi-

ronmental Chemistry As It Relates to the Community," cosponsored with the Northeast Georgia Section of the American Chemical Society. The teachers learned innovative skills for enhancing their high school science courses. Ms. McDaniel participated as a volunteer instructor in the Presidential Classroom for Young Americans, a week-long session for high school juniors and seniors in

Washington DC. The Lab was awarded a grant for environmental education through the Agency's Minority Cooperative Education Program. The grant will be used to support a Master's Candidate in Environmental Risk Management and to participate in a National Community Outreach Program. Lab staff continued their mentoring activities with students at the 4th Street Elementary School in Athens, our Partner in Education.  
[K. McDaniel, 706-546-3524]

## Staff Honors and Awards

### Achievement Awards to Azarraga, Barnwell

Dr. Leo Azarraga and Mr. Thomas Barnwell received EPA Science Achievement Awards for 1992. Recipients are selected by a panel chaired by EPA's Scientific and Technical Careers Advisory Committee and including professional society representatives to recognize Agency scientists for outstanding contributions in specific technical fields. Each award is established in conjunction with a professional society.

Dr. Azarraga's award, in the field of chemistry, is granted "for innovative development and application of laser spectroscopy and the Competitive Equilibrium Gaussian Distribution Model to the quantitative understanding of toxic metal speciation in environmental and biological systems."

Mr. Barnwell's award, in the field of water quality, is provided "for insightful leadership in applying state-of-the-art modeling and computing concepts to meet high priority Agency water quality modeling needs."

### Lab Papers Win Sci-Tech Awards

A journal article by Dr. Craig Barber, Dr. Luis Suarez, and Dr. Ray Lassiter claimed top honors in this year's presentation of the EPA Office of Research and Development's Scientific and Technological Achievement Awards. The Level I award, one of only two presented, went to "Modelling Bioaccumulation of Organic Pollutants in Fish with an Application to PCBs in Lake Ontario Salmonids."

EPA's Science Advisory Board also awarded Level III honors to two Lab articles. The articles were "Ester Hydrolysis Rate Constants Prediction from Infrared Interferograms" by Dr. Timothy Collette and "Regiospecific Dechlorination of Pentachlorophenol by Dichlorophenol-Adapted Microorganisms in Freshwater, Anaerobic Sediment Slurries" by Dr. John Rogers (EPA coauthor).

In the overall process for recognizing outstanding research by EPA employees, the Science Advisory Board granted 29 awards from the 114 scientific articles nominated by 16 EPA Labs and Offices.

### Rogers Heads Bioremediation Committee

Dr. John Rogers was named Chair of the Scientific Steering Committee (Matrix Manager) for the Office of Research and Development's Bioremediation Research Program. The committee recommends resource allocations and directs the bioremediation programs that support Superfund and hazardous waste cleanup activities.

### McCutcheon Named Journal Editor

The American Society of Civil Engineers selected Dr. Steve McCutcheon for a 2-year voluntary appointment as editor of the *Journal of Environmental Engineering*. In this honorary position, he will provide editorials and editor's notes bearing on the needs of the environmental engineering profession.



## **Russo Serves on NAS Committee**

Dr. Rosemarie Russo serves on the National Academy of Science's Advisory Committee on Russia and the Newly Independent States. The Committee provides advice to the leadership of the Academy on scientific and technological issues related to the former Soviet Union and advises on most appropriate activities for the NAS in support of U.S. interests.

## **Richardson Takes AWWA Post**

Dr. Susan Richardson was appointed to a research committee of the American Water Works Association. The committee reviews research proposals and provides continuing oversight of research in progress.

## **ACS Recognizes Zepp**

The American Chemical Society's Division of Environmental Chemistry selected Dr. Richard Zepp to receive its Distinguished Service Award for 1992. The award recognizes Dr. Zepp's activities on the Environmental Chemistry Executive Committee.

## **Barnwell Named to ASCE Council**

Mr. Thomas Barnwell accepted appointment to the Executive Committee of the American Society of Civil Engineers' Technical Council on Computer Practices.

## **Russo Given Polish Medal**

The Institute of Meteorology and Water Management in Warsaw, Poland, presented its Gabriel Narutowicz Medal to Dr. Rosemarie Russo. The medal was awarded for Distinguished Service to Environmental Science and Engineering.

## **Loux on Journal Editorial Board**

The Editorial Board of Science and Technology Letters, Middlesex, United Kingdom, selected Dr. Nicholas Loux for a 1-year, voluntary, honorary appointment as an American Editor for *Chemical Speciation and Bioavailability*.

## **Burns Named to Risk Assessment Forum**

EPA's Risk Assessment Council named Dr. Lawrence Burns to its Risk Assessment Forum. The 13-member Forum promotes Agency-wide consensus on risk assessment issues and assures that this consensus is incorporated into appropriate risk assessment guidance.

## **Zepp, Burke Get Innovative Research Funding**

A research proposal by Dr. Richard Zepp and Dr. Roger Burke was selected for award under the Office of Research and Development's Innovative Research Program. The 1-year project will develop an improved understanding of the role of fire in climate-biosphere interactions through the examination of polycyclic aromatic hydrocarbon content in selected environmental samples that have served as natural archives of past fire events. The research will be conducted in collaboration with experts at the U.S. Forest Service and Duke University.

## **Lewis Is Sigma Xi Secretary**

Dr. David Lewis, Research Microbiologist at the Athens Lab, was elected Secretary of the University of Georgia Chapter of Sigma Xi, the National Scientific Research Society.

### New Soil Scientist

Dr. Dermont Bouchard, Research Soil Scientist, joined the Lab staff in August and assumed direction of the Center for Exposure Assessment Modeling. An EPA employee since 1985, Dr. Bouchard came to the Lab from a research liaison assignment between EPA and the USDA Agricultural Research Service in Beltsville MD. Prior to that he was ORD's Regional Scientist at EPA Region 7. He began his EPA career at the R.S. Kerr Environmental Research Laboratory-Ada OK. He has a Doctorate in Agronomy from the University of Arkansas.

### New Analytical Chemist

Ms. Dalizza Colon, who holds a Master's Degree in Analytical Chemistry from the University of Puerto Rico, joined the staff in August. Her current research examines the binding of atrazine and its degradation products to natural organic matter.

### Science and Management Fellow

Ms. Ida Rosario-Heber, an Environmental Science and Management Fellow, Class of 1993, under the National Urban Fellow's Program, joined the staff for a year-long residency. As a Special Assistant to the Laboratory Director, she participates in the Lab's environmental education program and is conducting an Environmental Education Assessment Survey for Educators.

### New NRC Associates

Two scientists joined the staff under the National Research Council Associates Program. Dr. William Miller's research examines photochemical carbon transformation in natural systems as part of the Lab's Global Change Research Program. Dr. Matthew Tarr is performing fundamental studies of photochemical transformations of pollutants on plant surfaces.

### DOE Research Visitor

Ms. Louise Criscenti of the Department of Energy/Battelle Northwest Laboratory joined the Lab on a year-long Interagency Agreement. She is assessing the use of subsurface geochemical and reactive solute transport models in regulatory decision-making at Superfund and hazardous waste sites, and testing the applicability of new models in interpreting field and laboratory data.

### International Research Visitors

Eight scientists from six countries visited the Laboratory for periods of 2 to 12 months to carry out joint research with staff experts. The visitors represented the National Institute for Public Health and Environmental Protection, Bilthoven, The Netherlands; the State Key Laboratory of Environmental Aquatic Chemistry, Chinese Academy of Sciences, Beijing, PRC; Institute of Meteorology and Water Management, Warsaw, Poland; Central Pollution Control Board, New Delhi, India; CIBA-Geigy Corporation, Basel, Switzerland; and the University of Catalonia, Barcelona, Spain. The Lab hosted brief (day-long) visits of scientists from Japan, Germany, The Netherlands, Brazil, Venezuela, South Africa, and the Czech and Slovak Federal Republic.

### Chemist Begins Research in Germany

Dr. Wayne Garrison, Chemistry Branch Chief, began an 11-month joint investigation of the environmental fate of pollutants at the Institute for Ecological Chemistry of the GSF Research Center for the Environment and Health, Munich, Germany.

## Publications in 1992

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