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NIES Annual Report 2002

National Institute for Environmental Studies

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National Institute for Environmental Studies

Foreword

This booklet is the first annual report from the new look NIES. Although NIES has been recently transformed from a research institute of the Japanese Government to an independent research agency, our mission—environmental studies—remains unchanged; moreover, we have added a new activity, research on recycling. However, the structure and administration of the institute have been completely reorganized—NIES now has 6 research divisions, 6 special priority research projects, 2 policy response research centers, and 2 groups studying fundamental research techniques. Several supporting divisions and the Center for Global Environmental Research have also been included. The institute's structure has been reorganized to respond quickly to the needs of research, government, and society. New facilities (the Bio-eco Engineering Research Laboratory, the Research Center for Material Cycles and Waste Management, and the Microbial Culture Collection) have been built, contributing to our advanced research activities.

During fiscal year 2001, all the members of NIES have devoted a large part of their time adapting themselves to the new system. Many readjustments were proposed and are still being proposed. Our research activity, however, has been enhanced and the researches together with organizational results are summarized in this report. This year's report has a new structure—it is based on our research activities and differs from former reports that were based on organizational performance.I hope this annual report will help you become familiar with our achievements and activities during 2001.

Yohichi Gohshi
President of NIES

Contents

During the 1950s and 1960s, Japan experienced serious environmental pollution accompanying the rapid economic growth. In 1971, the Environment Agency was established within Japanese Govenment to develop countermeasures to serious environmental pollution problems such as Minamata disease caused by poisoning with organic mercury contained in the waste water of some factories and chronic bronchitis and asthma caused by sulfur oxides emitted from the factories of large industrial complexes. Since the promotion of basic research on environmental sciences was very necessary and could address public needs, the National Institute for Environmental Studies (NIES) was established in 1974 at Tsukuba Science City, about 50km north of Tokyo as a branch of the Environment Agency. NIES is the sole national institute for comprehensive research in the environmental sciences.

Researchers at NIES are of various specialties including physics, chemistry, biology, health sciences, engineering, economics, etc. Interdisciplinary joint studies have been carried out, particularly in project research studies. There are various types of specially designed experimental facilities as well as remote research stations like the Lake Kasumigaura Water Research Station and GHGs' Monitoring Station in Hateruma and Cape Ochi-ishi.

For these two decades, rapid, technological progress, structural changes in industries and changes in the styles of our daily lives have added new problems for environmental science to deal with. Moreover, global environmental problems, such as global warming, depletion of the stratospheric ozone layer, acid rain, destruction of tropical rain forests, desertification, etc., have recently given rise to deep concern worldwide. NIES underwent a major reorganization on July 1, 1990 to conduct more intensive research both on global environmental changes and their effects, and on conservation of the natural environment. The research functions of the new organization are conducted within two project research divisions, six fundamental research divisions and the Center for Global Environmental Research. The Environmental Information Center has the additional functions at preparing and providing access to both research publications and environment related data bases. On January 2001, in the context of re-organization of Japanese government, the Environment Agency was promoted to the Ministry of the Environment, which newly covered waste management issue. At the same time, NIES established Waste Management Research Division to conduct waste management research.

On 1 April 2001 the National Institute for Environmental Studies was reborn as an Independent Administrative Institution. The change from being a governmental institute to the new independent status allows us more flexibility in our operations, in order to provide better services to society.
NIES has prepared the medium-term plan that sets down our five-year work plans corresponding to the Ministry of the Environment's medium-term objectives. NIES hopes to obtain the understanding and support of the public by articulating its research orientations and objectives, and will disseminate the results of its research widely.

As of the end of FY 2001, the total number of NIES permanent personnel was 277 (Table 1). In FY 2001, NIES invited 383 scientists (7 foreigners included) to carry out the research programs as occasion demanded and also 224 researchers (77 foreigners included) joined NIES's research activities. The total budget of FY 2001 was 12,750 million yen (Table 2).

Table 1
Number of Permanent Personnel

Research	206	74.4%
Support & Management	48	17.3%
Env. Information Center	15	5.4%
Center for Global Env. Research	8	2.9%
Total	277	100%

(as of FY2001)

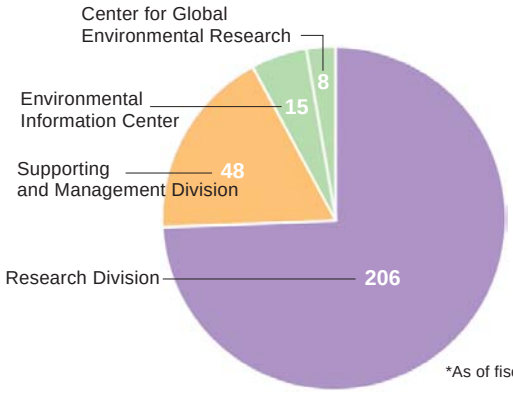
Table 2
Budget for Medium-Term Plan of NIES

	Category	2001-05 Budget(5years)		Fiscal 2001 Budget	
		million $	million ¥	million $	million ¥
Revenues	Grant for Operating Costs	407	48,849	77	9,250
	Subsidies for Facilities	15	1,859	3	300
	Commissioned Work	146	17,576	27	3,200
	Total	569	68,284	106	12,750
Expenditures	Project Costs	266	31,873	49	5,891
	for Special Priolity Research Projects	59	7,050	11	1,321
	for Policy-Response Research Areas	34	4,109	7	794
	for Environmental Information	18	2,132	3	412
	Facility improvements	15	1,859	3	300
	Expenses for Commissioned Work	146	17,576	27	3,200
	Personal Expenses	121	14,545	24	2,889
	General Administrative Expenses	20	2,431	4	470
	Total	569	68,284	106	12,750

NOTE: $1=¥120

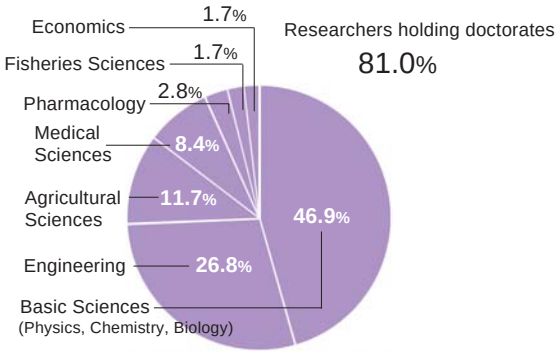
Number of Permanent Staff

277



Fields of Expertise

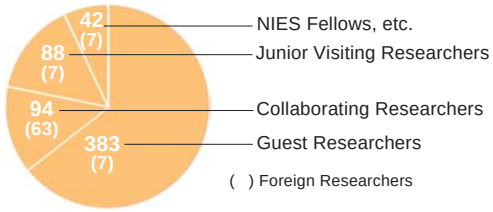
210



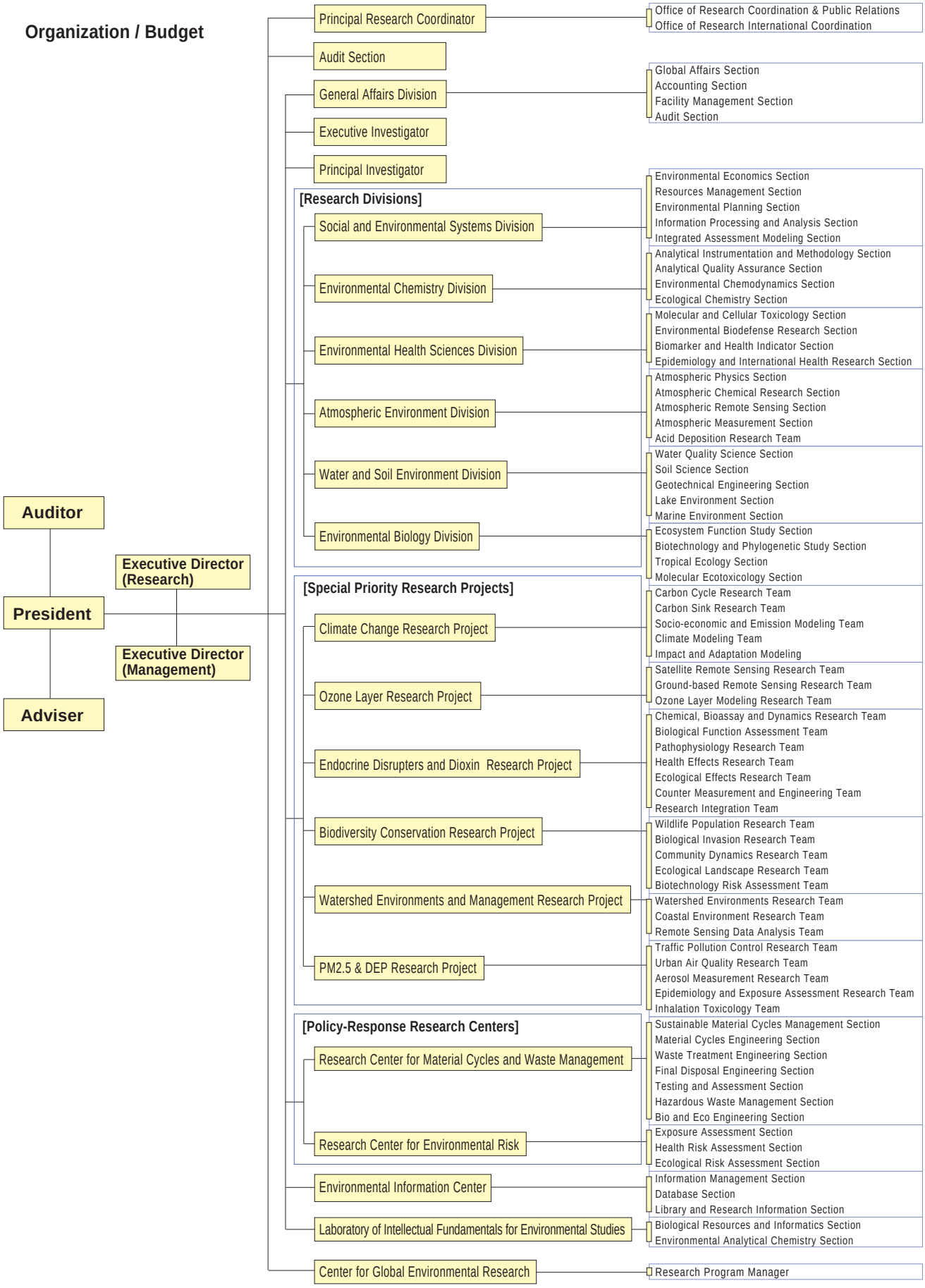
*As of fiscal year 2001

Number of Visiting Researchers

607(84)



Organization / Budget



Organization

Social and Environmental Systems Division

This division targets the linkages between human activities and the natural environment to clarify the relationships between socioeconomic systems and environmental issues. The work of the division results in proposals for environmental policies. It covers a broad area, from global environmental issues such as global warming, to issues around us such as recycling, to research focusing on the natural environment such as observations and analyses of forests with satellite data.

Within this division, the Environmental Economics Section conducts studies relating to the economic and policy-related aspects of environmental conservation. It analyses the economic and political consequences of environmental policies, and it also estimates the effectiveness of economic instruments such as carbon taxes. The Resource Management Section studies the relationships between the consumption of natural resources and the generation of environmental impacts. It also develops and applies assessment techniques, including material flow analyses and life cycle assessments. The Environmental Planning Section is working on planning and evaluation techniques and applications relating to environmental conservation, including setting local goals for environmental policies, as well as predictions of global warming and assessment of its impacts. The Information Processing and Analysis Section uses satellite data and geographical and statistical information in an integrated way to conduct environmental analyses, which include modeling and assessments of global, regional, and urban environments. The Integrated Assessment Modeling Section is developing a set of integrated environment-economy models for assessing environmental policies, such as those of global warming mitigation and sustainable development policies in the Asia-Pacific region.

Environmental Chemistry Division

The Division of Environmental Chemistry with its 4 research sections develops analytical and geochemical methods to examine chemical aspects of the environment.

The Analytical Chemistry and Instrumentation Section has developed new analytical methods and instrumentation, including a new X-ray detector capable of working at room temperature, new methods of monitoring the wind-blown yellow sand from China and determining nitrogen isotope ratios in groundwater.

The Analytical Quality Assurance Section has developed methods for analytical quality control by evaluating the most appropriate environmental analytical methods and supplying reference materials. Methods of measuring fine particles and volatile organic compounds (VOCs) in the atmosphere were also studied.

The Environmental Chemistry Section has developed methods for chemical speciation by using LC/ICP/MS and methods for measuring stable isotopes and radio-labeled carbon by using accelerator mass spectrometry. A weathering process that produces clay minerals from rocks is also being studied.

The Ecological Chemistry Section has studied the biological effects of chemicals, focusing especially on organo-tin compounds inducing reproductive failure in sea snails including abalone.

In addition to the above, 3 senior research scientists have, respectively, developed a new mass spectrometry method that uses Li^+ ion addition ionization, analyzed the fates of methyl halides and other VOCs on a global scale, and analyzed the sediment of Lake Baikal.

Environmental Health Sciences Division

The mission of the Environmental Health Sciences Division is to study the possible effects on human health of harmful environmental chemicals, such as dioxins, environmental endocrine disrupters, heavy metals, air pollutants, and physical factors, such as UV radiation and electromagnetic fields. From this perspective, we aim to have the knowledge and information obtained from these studies utilized to provide a scientific basis for risk assessment of these agents, either alone or in combination. There are 4 research sections in this division: the Molecular and Cellular Toxicology Section, the Environmental Immunotoxicology Section, the Biomarker and Health Indicator Section, and the Epidemiology and International Health Research Section. In the first 2 sections, laboratory animals are utilized as experimental models for extrapolation to humans. Although the use of laboratory animals is essential to study how environmental chemicals affect humans, the importance of alternative or functional *in vitro* models that can replace laboratory animals is also recognized; this approach is thought to be appropriate not only for the welfare of animals, but also for the innovation of new technologies to provide convenient technical tools for the basic understanding of toxicity mechanisms. The objective of the third section is to develop new methodologies using both human and animal models for detecting the health effects of environmental chemicals. Genetic differences in the susceptibility to heavy metals are studied in this section. The fourth section deals with the analysis of trends in various disease conditions with special reference to environmental factors, and with inferring the causes of disease among the human population. The relationships between atmospheric pollutants and respiratory symptoms in human populations are investigated in this section. These 4 sections collaborate with each other for the better understanding of health risk analysis and the toxicological mechanisms of environmental hazards.

Atmospheric Environment Division

This division consists of 4 sections and 1 team: the Atmospheric Physics Section, the Atmospheric Chemical Reaction Section, the Atmospheric Remote Sensing Section, the Atmospheric Measurement Section, and the Acid Deposition Research Team. In this division, fundamental studies are carried out with the emphasis on the research areas such as “Global Environmental Issues with special Emphasis on Climate Change”, “Integrated Management of the Environment”, “Environmental Issues in Developing Countries”, and “Monitoring Systems Finding Solutions and Responses to Environmental Problems”. These fundamental studies can give the foundation for solving global environmental problems, including global warming, stratospheric ozone depletion, and acid deposition, and regional environmental problems, including that of suspended particulate matter (SPM) in large cities. Many of the members of this division also work for Special Priority Research Projects such as Climate Change Research, Ozone Layer Research, and PM2.5 & DEP Research, and for the Center for Global Environmental Research.

Water and Soil Environment Division

This division conducts both fundamental and applied research on the transport, biological degradation, and chemical reactions of pesticides, organic matter, heavy metals, and chlorinated aliphatic compounds, as well as research on biologically available nutrients in aquatic and soil systems. The results of these studies are integrated into biogeochemical models to contribute to the conservation and protection of the environmental quality of such systems.

The division consists of 5 sections: the Water Quality Science Section, the Soil Science Section, the Geotechnical Engineering Section, the Lake Environment Section, and the Marine Environment Section.

The Water Quality Science Section has been conducting research on the restoration of polluted environments. It is identifying and strengthening the effectiveness of special microbes that can clean soil contaminated with trichloroethylene and other substances.

The Soil Science Section has been studying the impacts on soil and plant ecosystems of agricultural chemicals, synthetic organic compounds (such as organic halogenated compounds), antimony (from vehicle exhausts), bismuth (which has replaced lead in solder), and other substances. It is also studying the behaviors of these pollutants in soil and sediment.

The Geotechnical Engineering Section has been conducting long-term monitoring of subsidence conditions and groundwater levels where problems with these are most severe, and conducting simulations based on repeated soil compaction.

The Lake Environment and Marine Environment Sections have been conducting field research on the quantitative and qualitative changes in pollutants in rivers, lakes, wetlands, and seas, and have been building databases with the results. Target areas include Lake Kasumigaura and the Seto Inland Sea in Japan, and further afield, the East China Sea.

Environmental Biology Division

The Environmental Biology Division consists of 4 sections: Ecosystem Function Study, Biodiversity and Phylogenetic Study, Tropical Ecology, and Molecular Ecotoxicology. The Ecosystem Function Section includes research into the management of wetland ecosystems, the suitability of natural populations of firefly as an indicator of the state of the environment, the classification and ecology of lotic macro-invertebrates, the conservation and restoration of endangered aquatic macrophytes in brackish water, and the ecological traits of alpine plants endangered due to global warming. The Biodiversity and Phylogenetic Section includes research into genetic and morphological variations in microalgae, functional diversity in microbial communities, life-stage analysis of coccolithophorids, and construction of a taxonomic species index of chironomids based on larval head morphology. In the Tropical Ecology Section, we study the ecological service in the tropical forests of Peninsular Malaysia, such as carbon stocks in and sequestration by forest and agricultural lands, and the biodiversity and socioeconomic value of the tropical rainforests. The Molecular Ecotoxicology Section aims to elucidate how phototoxic air pollutants (such as ozone), UV light, and drought affect plants and how plants respond to protect themselves from these factors. Molecular genetic studies are conducted using various stress-related mutants of *Arabidopsis thaliana*.

Climate Change Research Project

Using the outcomes from research over the past 10 years at NIES, this project aims to respond to new policy needs arising from the Kyoto Protocol, post-Kyoto negotiations, and long-term integration between climate policies and sustainable development policies. To promote this aim, 2 research sub-projects were organized: the integrated modeling project and the carbon cycle research project.

The integrated modeling sub-project aims to develop a set of models for the integrated assessment of economic growth, climate change, and the impacts of climate change; it will apply these models to estimate the effects of Kyoto and post-Kyoto interventions on global climate change and the regional impacts of this global climate change. The sub-project will also clarify the most effective future strategies to integrate sustainable development in Asia with climate change mitigation in relation to alternative paths of future development. Three research teams are involved in this sub-project: the Socioeconomic and Emission Modeling Team, the Climate Model Research Team, and the Impact and Adaptation Modeling Team.

The carbon cycle research sub-project analyzes and estimates the ratio between terrestrial and ocean carbon absorption, carbon emissions from and absorptions by forests, and the impacts of climate change on these absorptions and emissions, based on field observations, remote sensing, and statistical data. Two research teams are involved in this sub-project: the Carbon Cycle Research Team and the Carbon Sink Assessment Team.

Ozone Layer Research Project

In this project we observe and investigate the stratospheric ozone layer with the use of a satellite-borne sensor for high-latitude observations and ground-based remote sensors installed in the mid-latitudes (Japan). The data from these sensors are provided to members of the domestic and international scientific community who are monitoring ozone layer changes and investigating its mechanisms. In addition, we conduct data analysis and numerical modeling studies to accumulate and disseminate scientific knowledge concerning mechanisms of ozone layer change and to contribute to predicting and verifying future ozone layer change. Three research teams are conducting our research activities: the Satellite Remote Sensing Research Team, the Ground-based Remote Sensing Research Team, and the Ozone Layer Modeling Research Team. The Improved Limb Atmospheric Spectrometer-II (ILAS-II), developed by the Ministry of the Environment and scheduled to be launched in late 2002, will generate data on the stratospheric ozone layer. The ILAS-II Data Handling Facility has been established in this project and data from ILAS-II will be processed, analyzed, and distributed through this project.

Endocrine Disrupters and Dioxin Research Project

In the NIES Endocrine Disrupters and Dioxin Research Project, which utilizes the new Endocrine Disrupter Research Facility, 7 research teams have been developing measurement methods, evaluating the current status of environmental pollution, assessing hazards and effects, and developing countermeasures and integrated information systems:

1) The Chemical, Bioassay, and Dynamics Research Team has developed highly sensitive chemical determination methods including LC/NCI/MS, LC/ECD, and GC/HRMS, as well as *in vitro* bioassay methods.
2) The Biological Function Assessment Team is developing an MRI method for examining the effect of EDCs on brain structure and function.
3) The Pathological Function Assessment Team is working to identify the effects of EDCs on neurology and behavior.
4) The Health Effects Research Team is examining the reproductive toxicity and developmental toxicity of EDCs, especially dioxins, through animal experiments.
5) The Ecological Effect Research Team is studying the effects of EDCs on wildlife, including sea snails, fish, crustaceans, and insects.
6) The Countermeasures and Engineering Team is developing new methods for the monitoring and treatment of dioxins and EDCs.
7) The Research Integration Team is developing new information systems for assessing the environmental fates and impacts of dioxins and EDCs.

Biodiversity Conservation Research Project

In the Biodiversity Conservation Research Project, we are developing methods to assess changes in biodiversity on a variety of spatial scales, and are researching ecological disruption from invasive species and genetically modified organisms. The possibility of wildlife species becoming extinct is increasing as individual habitats shrink due to human activities that cause their destruction and fragmentation. Based on ecological and geographical information, we are developing methods to assess habitat suitability for several wildlife species by using technologies such as the GIS. In this project we are also assessing the role of the landscape complexity in maintaining diversity in aquatic ecosystems. To analyze the mechanisms of coexistence and extinction of species in plant communities, we are developing individual-based models to simulate the dynamics of plant populations. Of increasing concern is loss of biodiversity due to biological invasion that often occurs when a species alien to an area is introduced and becomes established in the environment. We have conducted several case studies of the impacts of alien species on native ecosystems. In recent years, the cultivation of genetically modified plants and the use of microorganisms for the remediation of polluted soils have come into question. We are developing a method to assess their safety in natural ecosystems and their ability to disperse into the natural environment.

Watershed Environments and Management Research Project

This is a research project on integrated environmental management in East Asia aided by modeling of ecosystem functions in river basins. The project consists of 3 teams: the Remote Sensing Data Analysis Team, the Coastal Environments Research Team, and the Watershed Environments Research Team.

Since river basins are basic environmental units necessary for supporting balanced development in Japan and other East Asian countries, we have focused on water circulation in East Asia, working to scientifically observe and understand the ecosystem functions of river basins connecting major rivers with the sea in China. In addition to developing methods to forecast the degradation and recovery of ecosystem functions through mathematical models of the river basin environment based on ecosystem functions, we will propose sustainable environment management strategies that will encompass the application of environmental recovery technologies, reevaluation of development plans, and ways of reducing environmental load.

PM2.5 & DEP Research Project

Air pollution from vehicle emissions continues to be a serious problem in urban areas. The $PM_{2.5}$ & DEP Research Project Group is carrying out investigations to better understand the characteristics of the sources of these pollutants, as well as the environmental fates of fine particulate matter and its effects on human health. Five research teams are studying the environmental behavior and health effects of $PM_{2.5}$ and DEP: 1) the Traffic Pollution Control Research Team mainly studies emission inventories and strategies for the reduction of particulate matter (PM) and diesel exhaust particles (DEP); 2) the Urban Air Quality Research Team is investigating the mechanisms of urban air pollution to understand the relationships between changes in the relative importance of various air pollution sources and the spatial and temporal distributions of urban air pollution; 3) the Aerosol Measurement Research Team has been investigating new technologies to measure particulates and gaseous pollutants; 4) the Epidemiology and Exposure Assessment Research Team is researching the extent of human exposure to $PM_{2.5}$ and DEP; and 5) the Toxicity/Impact Assessment Research Team is researching the toxicity of DEP and $PM_{2.5}$ caused by diesel engine exhaust.

Research Center for Material Cycles and Waste Management

The current economic and social system—so-called mass production, mass consumption, and mass disposal—is veering toward a Material Cycles Oriented Economy and Society. However, a precise map and compass for where the world is going and how it should arrive there is not yet available. Under these uncertain circumstances, in April 2001, the Waste Management Research Division at NIES changed its name to the Research Center for Material Cycles and Waste Management, and energetically set out to promote appropriate research. This research center intends to keep an eye on progress towards realizing a Material Cycles Oriented Society by way of developing methods for processing and analysing a wide range of information, innovative technologies, and monitoring techniques. The tools we intend to use in our research and policy development include the legal measures advance of high technologies, economic measures, information systems, and monitoring techniques. Many waste-related issues—from waste prevention to the recycling, treatment, and disposal of wastes—are the targets of our research: we will carry out research ranging from studies of waste characterization, hazard characterization and risk management, to practical studies of technological control methods and system development and assessment. We will tackle 4 main topics: 1) methods for assessing sustainability and the basic organization of a Material Cycles Oriented Society; 2) technologies for material recycling, treatment, and disposal; 3) comprehensive risk control methods related to the material cycles; and 4) remediation technologies for polluted environments. We are currently focusing on research concerning methods for assessing sustainability and the preparation of basic systems for supporting the conversion to a Material Cycles Oriented Society.

Research Center for Environmental Risk

Whenever a new type of pollution is discovered, the control of environmental risks from those chemical substances is strengthened. However, to keep up with the increasing complexity and proliferation of pollution from chemical substances, new countermeasures are constantly required. To properly manage environmental risk, it is essential both to accurately assess the risk and to reduce the social costs associated with the risk. When NIES became an independent administrative institution, the Research Center for Environmental Risk was created as a research facility to support the government’s measures to deal with chemical substances. The Center consists of 3 sections: the exposure assessment section, the human health risk assessment section, and the ecosystem risk assessment section. In the projects of these sections, research on methods to achieve an acceptable form of consensus is also promoted. In addition, methods for testing the ecotoxicity of chemical substances and bioassay methods for environmental monitoring are being developed.

Environmental Information Center

The activities of the Environmental Information Center are: a) to support research and related activities in NIES with information technology; b) to conduct public relations activities for NIES, and to publish NIES research reports, etc.; and c) to collect, process, and disseminate environmental information. To promote these activities, the Center has the following 3 sections:

(i) Information Management Section

The tasks of this section are: a) to plan and coordinate the activities of the Center; b) to manage and operate computers and related systems in NIES; and c) to be the national focal point of UNEP-Infoterra in Japan.

(ii) Database Section

The tasks of this section are: a) to collect and process information generated in NIES as well as other environmental information; and b) to disseminate the information by NIES-WWW, the Environmental Information & Communication Network (EICnet), etc.

(iii) Library and Research Information Section

The tasks of this section are: a) to manage the NIES Library and provide related services; and b) to publish the NIES Annual Report, research reports, etc.

Laboratory of Intellectual Fundamentals for Environmental Studies

This laboratory consists of 2 research sections: the Environmental Analytical Chemistry Section and the Biological Resource and Informatics Section. They are responsible for organizing all of the research fundamentals accumulated since NIES began and for developing the basic research techniques that will be needed in the future.

The laboratory produces and provides a series of environmental certified reference materials and analytical standards for environmental research. The laboratory, in collaboration with various long-term environmental monitoring programs within and outside of the institute, also provides long-term, low-temperature storage of environmental samples for retrospective analysis of pollutants—a so-called "Environmental Specimen Bank".

This facility also functions as a reference laboratory for environmental research in Japan through: 1) improving methods to ensure analytical quality control and cross-checking analytical techniques; and 2) improving the methods of classifying and identifying microalgae and laboratory organisms, and preserving and supplying these cells to provide standards for classification and standard strains for algal growth potential (AGP) tests.

Microbes and cells of endangered wildlife species have been collected and preserved for environmental conservation.

In addition to these research fundamentals, the laboratory has been managing and operating common-use analytical equipment.

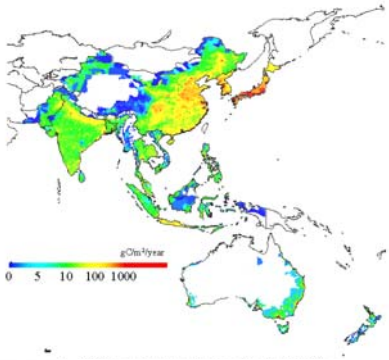
Center for Global Environmental Research

The Center for Global Environmental Research (CGER) was established in 1990 to promote and support global environmental research from both national and international points of view. CGER has 3 missions: synthesis of global environmental studies, support for global environmental research, and global environmental monitoring.

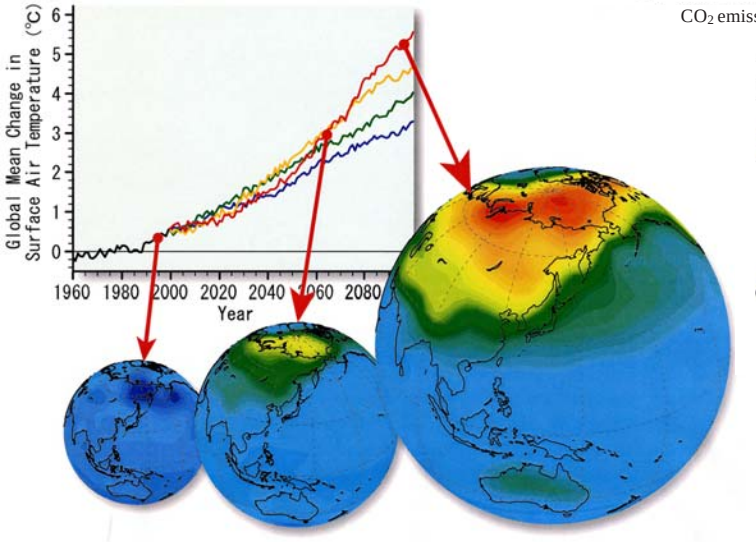
The Executive Director in charge of research activities at NIES is the head of CGER, and a director, 4 research program managers, 2 researchers, and 5 officers comprise the permanent staff. About 40 temporary staff, including post-doctoral fellows, assistants, and engineers from the private sector, work together here. More than 30 NIES scientists lead or cooperate in the monitoring and database compilation programs. Some of the programs are supported by scientists not within NIES.

The CGER office is in the Global Warming Research Hall. CGER also operates and maintains 2 monitoring stations, at Hateruma Island and Cape Ochi-ishi, and 2 flux research sites, at Tomakomai and Rikubetsu.

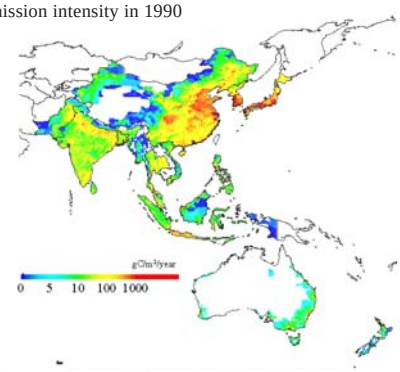
Climate Change Research Project



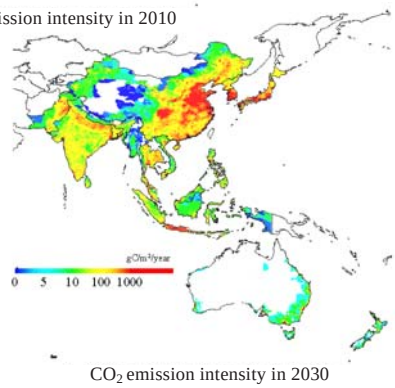
CO_2 emission intensity in 1990



Global warming projections using the CCSR/NIES climate model

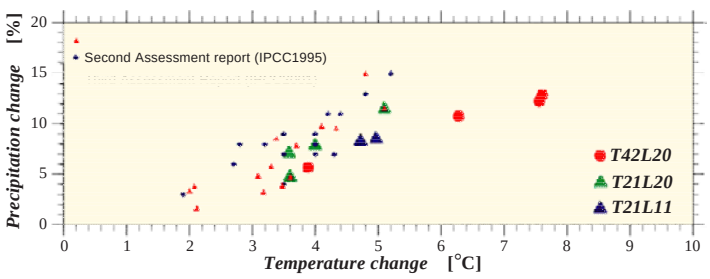


CO_2 emission intensity in 2010



CO_2 emission intensity in 2030

Precipitation change : (R (CO_2x2) — R (CO_2x1)) / R (CO_2x1)
Temperature change : T (CO_2x2) — T (CO_2x1)



Sub-project on carbon cycle research

The sub-project focuses the research about the state and future of the important natural carbon sinks such as terrestrial ecosystem and ocean. The ratio between terrestrial and ocean carbon sinks, carbon exchange in the forests, and climate impacts on the carbon sinks are analyzed and estimated from field observation, remote sensing and data statistics. The two research teams involved in this sub-project—the Carbon Cycle Research Team and the Carbon Sink Assessment Team—achieved the following outcomes in FY 2001.

The Carbon Cycle Research Team

The Carbon Cycle Research Team has observation programs from global scale to regional scale of atmosphere to elucidate the functions of terrestrial ecosystem and ocean. The observation programs have been cooperated with the monitoring programs for the atmospheric green house gases by the Center for Global Environmental Research (CGER) utilizing various platforms such as ground-based stations, aircrafts and cargo ships. The recent atmospheric CO_2 increase has been observed by these platforms with averaged increasing rate of 1.6ppm/y. However, significant inter-annual variability was also observed (Fig. 1).

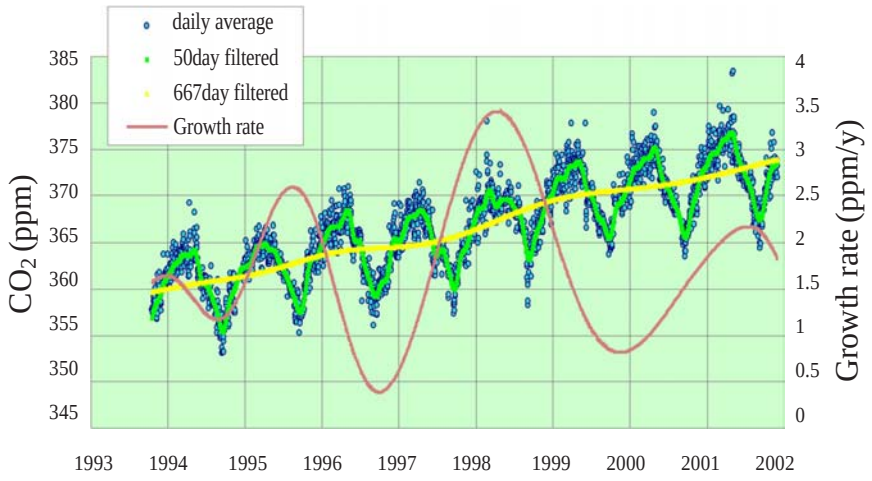


Fig. 1
CO_2 variation, trend and growth rate at Hateruma Atmospheric Monitoring Station.

Ancillary measurements of isotopes in CO_2 and atmospheric oxygen/nitrogen ratio can be the key to resolve the secular changes of natural carbon sinks as terrestrial ecosystem and ocean, which contributes the improvement of prognostic model for the global carbon cycles. Observation was also started using two cargo ships operated over the Pacific (Japan-US and Japan-Australia). Special glass bottle samplers for these analyses were developed and reasonable latitudinal variations for isotopes and oxygen/nitrogen ratio were obtained by the several test cruises. The terrestrial atmospheric observations were carried out in the Siberia and Hokkaido sites. Ground-based continuous measurement and intense aircraft measurement were conducted in the Siberian forest area. Optimizing combination of ground and aircraft observations

to estimate a CO_2 flux on the subcontinent scale was investigated. Temporal variations in stable isotope ratios of respired CO_2 in a deciduous needle-leaf forest canopy were investigated at Tomakomai Flux Research Site. Diurnal variations in atmospheric CO_2 mixing ratio and its stable isotope ratios were measured to evaluate the isotopic signature during the CO_2 exchange between atmosphere and land biosphere. The data set has been collected at the site since July 2000 in a Larix forest that is a representative for the north-east Eurasia. Estimated carbon isotope value of respired CO_2 showed significant temporal variation and was lower than the values reported for other boreal forest ecosystems. Relationship between the oceanic CO_2 sink and ocean surface biogeochemical processes was investigated from ocean monitoring by cargo ships and from field experiment. An oceanic iron fertilization experiment was carried out in the western sub-arctic Pacific in July 2001. Large increase of phytoplankton was observed which verifies the significance of iron supply to the ocean productivity in the area. The regional scale analysis of oceanic CO_2 monitoring data in the north Pacific showed an effect of air-bone iron supply to the ocean enhancing phytoplankton productivity in the Gulf of Alaska.

The Carbon Sink Assessment Team

The Carbon Sink Assessment Team developed (1) Global assessment of the potential carbon sink activities under the Kyoto Protocol based on the terrestrial ecosystem modeling (Fig. 2). (2) Advanced remote sensing techniques for measuring the vegetation parameters (3D structure etc) that are important for estimating the carbon stock changes (Fig. 3).

Especially, we obtained the following results from the first topic: The net flux estimates from the forestation/deforestation (including the total article 3.3 and some part of the 3.4 activities under the Kyoto Protocol) depends on the accepted projection of land-use changes. Using a projection of land-use changes based on demands for agricultural land and combining it with a simulation model of carbon stock changes we estimated the carbon offset potential to be as high as 0.2 GtC per year during the first commitment period.

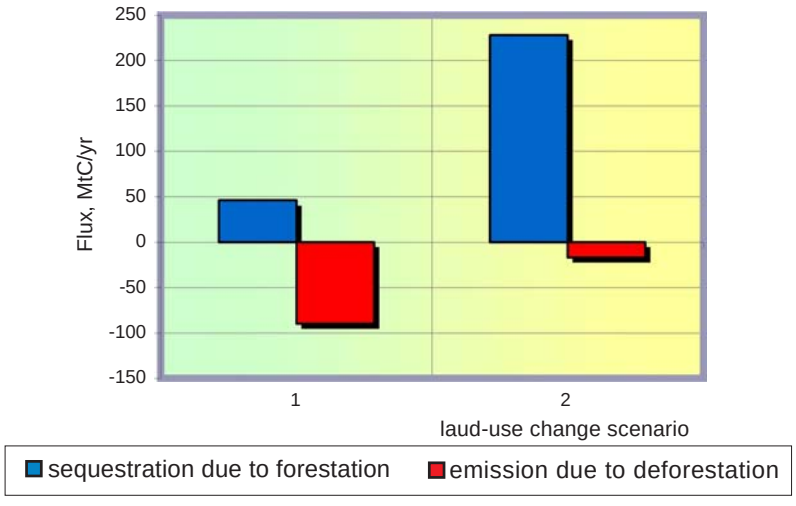


Fig. 2
The carbon fluxes predicted for Annex 1 countries by use of different projection of land use changes.

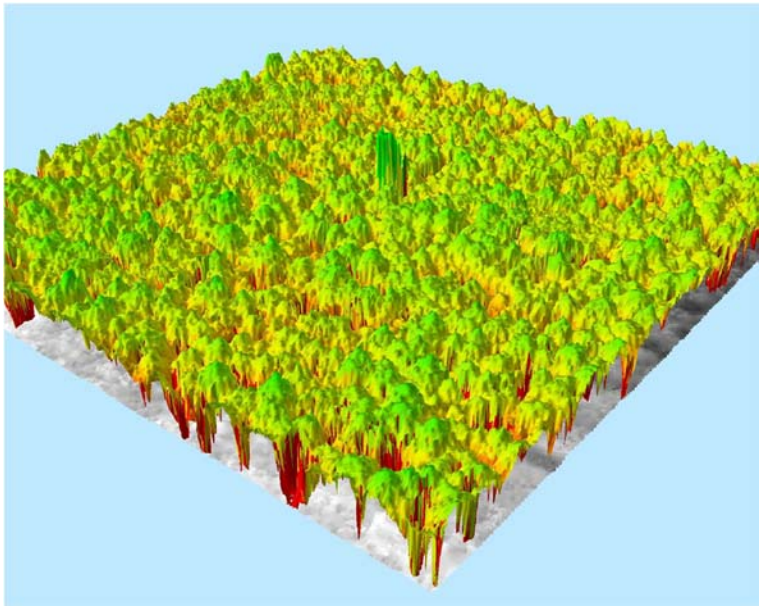


Fig. 3
3D View of Canopy Digital Surface Model using airborne laser lider data.

Sub-project on climate change scenarios and Asia-focused comprehensive mitigation strategies based on an integrated assessment model

On the basis of outcomes from research over the past 10 years at NIES, this sub-project aims to respond to new policy needs arising from the Kyoto Protocol, post-Kyoto negotiations, and long-term integration between climate policies and sustainable development policies. The target of this sub-project is to develop a set of models for integrated assessment of economic growth, climate change, and the impacts of climate change; it will then apply these models to estimate the effects of Kyoto and post-Kyoto interventions on global climate change and the regional impacts of this global climate change. The sub-project is also expected to clarify the most effective future strategies to integrate sustainable development in Asia with mitigation of climate change in relation to alternative paths of future development.

The 3 research teams involved in this sub-project—the Socioeconomic and Emission Modeling Team, the Climate Model Research Team, and the Impact and Adaptation Modeling Team—achieved the following outcomes in FY 2001.

The Socioeconomic and Emission Modeling Team

The Socioeconomic and Emission Modeling Team developed (1) emission models for greenhouse gases (GHGs) and air pollutants at a country and sub-country level for major Asian countries, (2) a new economic model to integrate the economy with energy and material flows to analyze the detailed relationship between GHG emissions and economic activities, and (3) a preliminary version of a new multi-regional, multi-sector general equilibrium model to analyze the interaction between world economic development and climate policies. These models were applied to analyses of climate change mitigation scenarios for various countries, analyses of emissions trading, cost analyses of the Kyoto Protocol (Fig. 4), and global climate change mitigation scenarios for the IPCC.

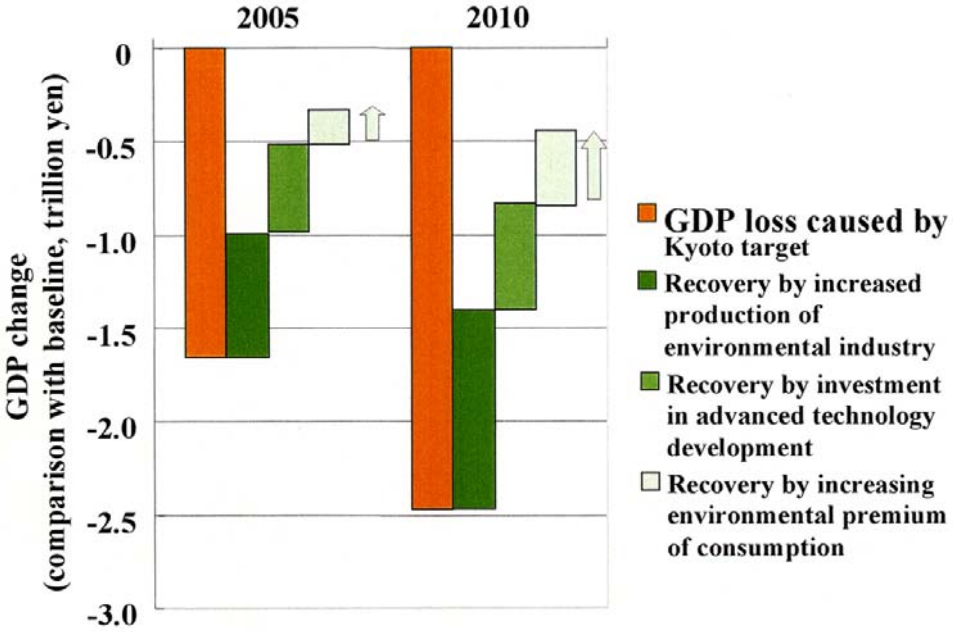


Fig. 4
Japanese reduction and recovery of GDP caused by Kyoto. (without international emission trade)

The Climate Model Research Team

The Climate Model Research Team assessed GCM simulation results to find directions in which to improve the model (Fig. 5), and collected various monitoring data to test GCM experiments. The team has also started to improve the resolution and precision of the GCM, and has started to develop a regional climate model for the Asia-Pacific region as an interface between the global GCM and climate impact models.

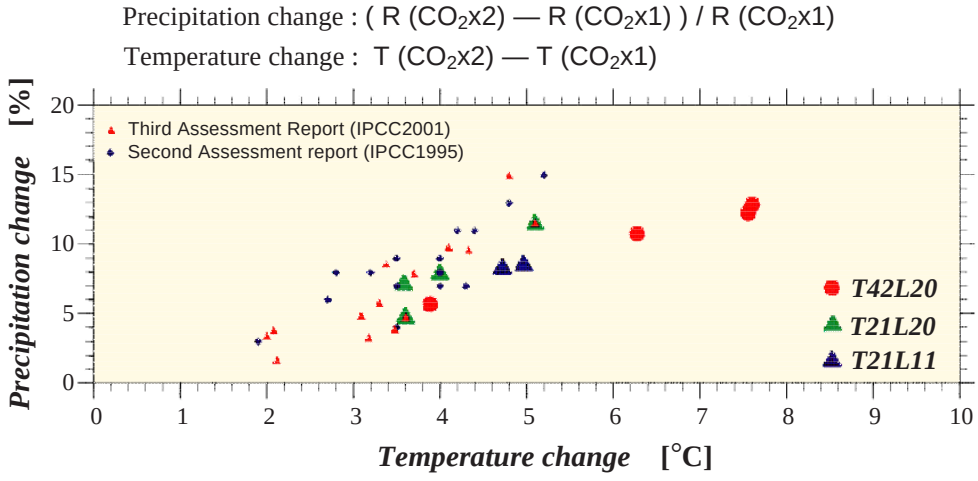


Fig. 5
Comparison of climate sensitivities among different resolution of GCM experiments.

The Impact and Adaptation Modeling Team

The Impact and Adaptation Modeling Team developed (1) a demand module for the water resource impact model to reflect irrigation, population, and other socioeconomic factors, (2) an economic model to assess the optimal investment of China in water management infrastructure with respect to climate change adaptation, and (3) an integrated urban-basin database to analyze the impact of climate change on water demand and pollutant emissions on an urban scale. These models and database were applied to assess regional impacts on the basis of IPCC climate change scenarios (Fig. 6).

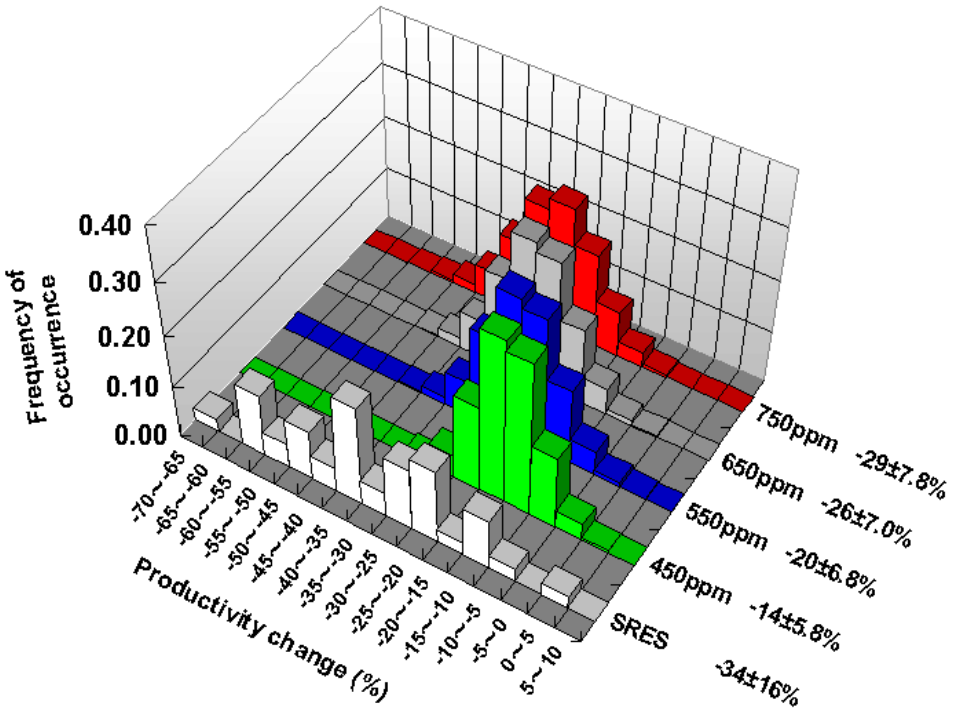
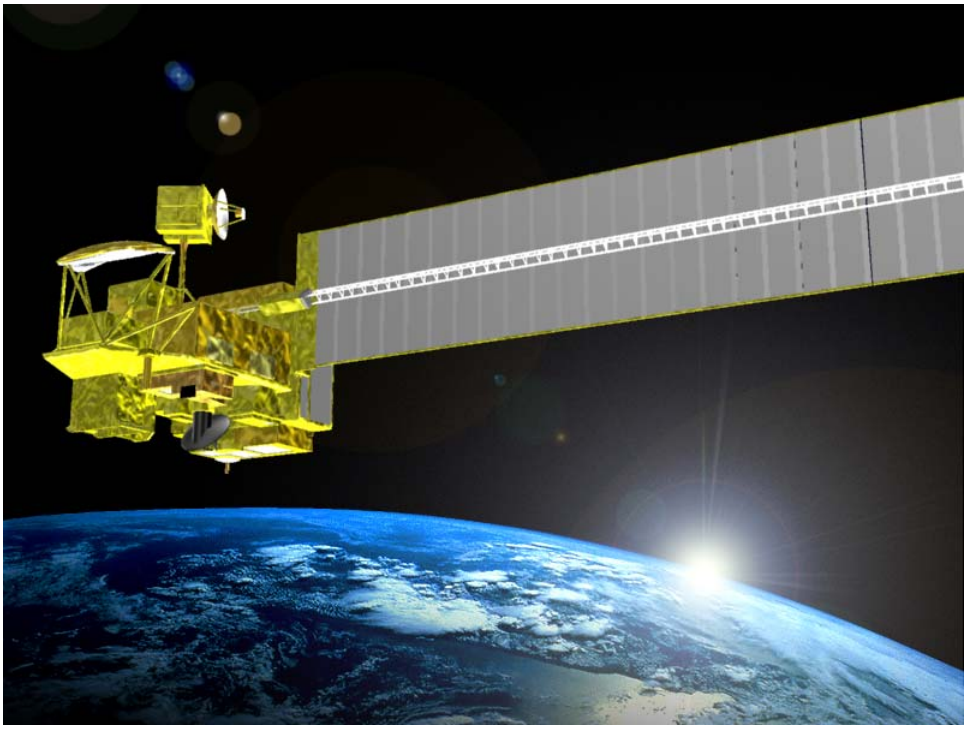
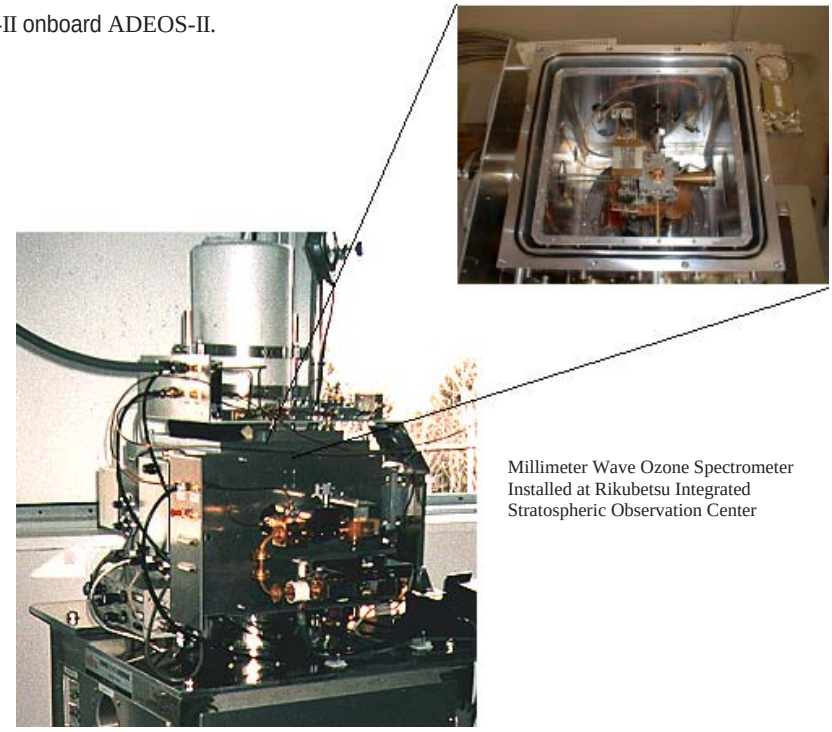


Fig. 6
Wheat productivity change in India from 1990 to 2100, with CO_2 fertilization.

Ozone Layer Research Project



Stratospheric ozone layer observation by ILAS-II onboard ADEOS-II.



Millimeter Wave Ozone Spectrometer Installed at Rikubetsu Integrated Stratospheric Observation Center

Background and Purposes

To counter the problem of ozone depletion due to specific chlorofluorocarbons and other substances, various measures have been taken based on the Vienna Convention for the Protection of the Ozone Layer, the Montreal Protocol on Substances that Deplete the Ozone Layer, and other relevant international agreements. As a result, the total content of organic chlorine compounds has started to decrease in the stratosphere. Nevertheless, results of observations show that, even considering the great annual variation, the Antarctic ozone hole still appears to be growing larger every year, and springtime ozone depletion over the Arctic is progressing. Therefore, it may not be appropriate to predict the scale of ozone depletion by chlorine content alone—continuous monitoring of the stratospheric ozone layer is required while we continue to improve our scientific knowledge of the meteorological conditions and climate of the stratosphere, the physical and chemical processes of polar stratospheric clouds, and the state of ozone depletion. Together with the Ministry of the Environment (MOE), we have been monitoring the ozone layer using a satellite-borne ozone sensor and ground-based remote sensing equipment, analyzing the data obtained, and conducting research using numerical models.

In our project we have been monitoring, and will continue to monitor, the ozone layer by using satellite-borne sensors for the high-latitude regions and ground-based remote sensing equipment for the mid-latitudes. Thus, we have gathered data both within and outside of Japan to help monitor, and identify the mechanisms of, variations in the ozone layer. The project also conducts data analysis and numerical modeling to accumulate scientific knowledge on the mechanisms of changes in the ozone layer, thus contributing to the prediction and validation of future ozone layer changes.

Objectives

The 5 main objectives for the mid-term stage of this project are: 1) acquisition and processing of data that will be obtained by the Improved Limb Atmospheric Spectrometer-II (ILAS-II). This is a satellite-borne ozone layer monitoring sensor developed by MOE, scheduled to be launched in late 2002, for providing ILAS-II data products to both within and outside of Japan for scientific use, such as research and monitoring of the ozone layer; 2) development of the data processing system and the ground-based operation system for the Solar Occultation FTS (Fourier Transform Spectrometer) for Inclined-orbit Satellite (SOFIS), which is the ILAS-II successor sensor to be launched in around 2007, in preparation for the commencement of SOFIS operations; 3) continued ground-based ozone layer monitoring at Tsukuba (NIES) and Rikubetsu (Rikubetsu Integrated Stratospheric Observation Center) for registering the obtained data in the Network for the Detection of Stratospheric Change (NDSC) database, which is an international network database, and providing the data to organizations both within and outside of Japan; 4) identification of the mechanisms and contributions of the processes of physically and chemically important elements in regard to polar ozone layer changes; and 5) validation of predicted future ozone layer changes as the basis for formulating various measures for protecting the ozone layer, as well as validation of the latest predicted ozone layer changes to provide expert knowledge for evaluating the effectiveness of the protection measures.

Achievements in Fiscal Year 2001

The ILAS-II data processing and operation system was revised, and a performance test confirmed its operational performance to be satisfactory. To receive data that will be obtained by ILAS-II, an exclusive line was installed connecting the ILAS-II data processing and operation system at the ILAS-II Data Handling Facility (ILAS-II DHF) with the National Space Development Agency of Japan (NASDA). A file transmission test confirmed that the line was functioning normally. In addition, research and development of the SOFIS data processing and operation systems were conducted. Analyzing data obtained since 1996 with the millimeter-wave ozone spectrometer installed at NIES revealed semi-annual variations in ozone at an altitude of 60 km. In addition, we investigated a broadband data acquisition function for enabling continuous measurements of ozone from the lower stratosphere to the upper stratosphere. By comparing 5 datasets measured by the millimeter-wave ozone spectrometer at the Rikubetsu Integrated Stratospheric Observation Center and by the satellite sensor SAGE-II, we found that the data agreed within around 10% for altitudes ≥ 22 km and when the measurement positions were closest. In February 2001, ozone was observed to decrease when the polar vortex appeared. By reanalyzing the data obtained with the ozone laser radar at NIES, we obtained vertical profiles of ozone, temperature, and aerosols with good consistency.

Using the improved Match Technique, we estimated the amount of ozone depletion over the Arctic region in the spring of 1997 based on the data obtained by the satellite-borne sensor, ILAS. Figure1 shows the rates of ozone change per day as a function of potential temperature (height) and date; we found that the integrated ozone loss during February through March reached 1.9 ppmv (about 55% of the initial value) at the 450-490 K levels and 475-529 K levels in the Northern polar region in 1997. Furthermore, the mixing process of atmospheric trace species on the meridian plane at the breakup of the polar vortex was visualized; by using N_2O data obtained by ILAS as a tracer, we determined the dependence of the descending motions of air masses inside the polar vortex on the equivalent latitude over the Southern Hemisphere in 1997.

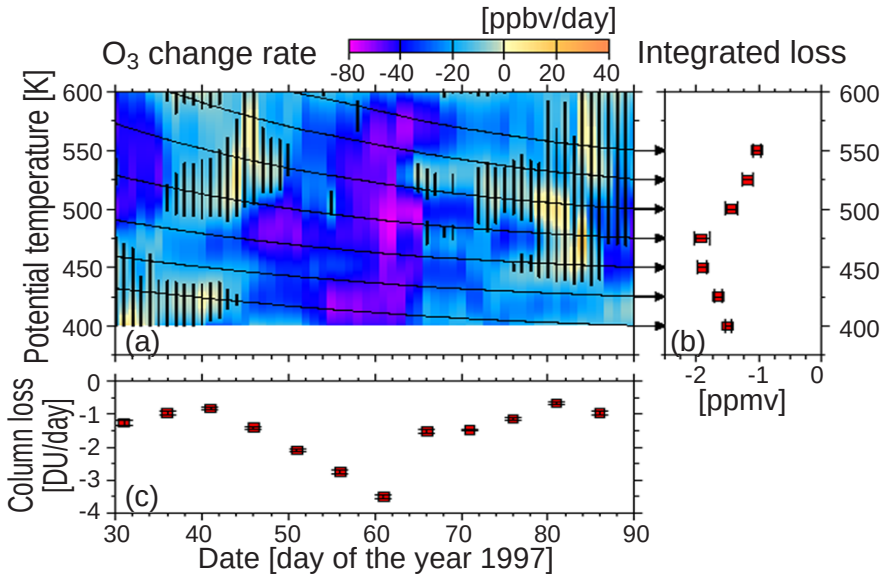


Fig.1
(a) Color-coded ozone change rates (in ppbv per day) as functions of potential temperature and date. Vertical bars indicate the regions with statistical significance < 99%. Smooth thin curves show potential temperature changes of air parcels (diabatic descent of air masses). (b) Integrated ozone changes from January 30 (day 30) to March 31 (day 90) along each descent curve of the air mass. For the 2 uppermost levels, days 51-90 and days 37-90 are used for the integration, respectively. Error bars represent 1σ. (c) Ozone column change rates (in Dobson Units per day) obtained by integrating local ozone change rates (in number density per day) from 400 to 600 K. This figure was adopted from Terao et al. [2002].

Through joint research with the Center for Climate System Research at the University of Tokyo (CCSR), we are developing an atmospheric general circulation model with coupled chemistry (CCSR/NIES AGCM). This fiscal year, we conducted a numerical simulation with the AGCM to identify the influence of a huge amount of SO_2 injected into the stratosphere due to a volcanic eruption. The simulation successfully reproduced the observed data of optical thickness due to sulfuric acid aerosols. The model calculations suggested that increased quantities of sulfuric acid aerosol enhance the chemical loss of ozone.

Recently, we have been working on collecting kinetic data on heterogeneous reactions to estimate the partitioning of chemical species that contribute to ozone depletion in the stratosphere. We found that formic acid, which we expect to be produced by the

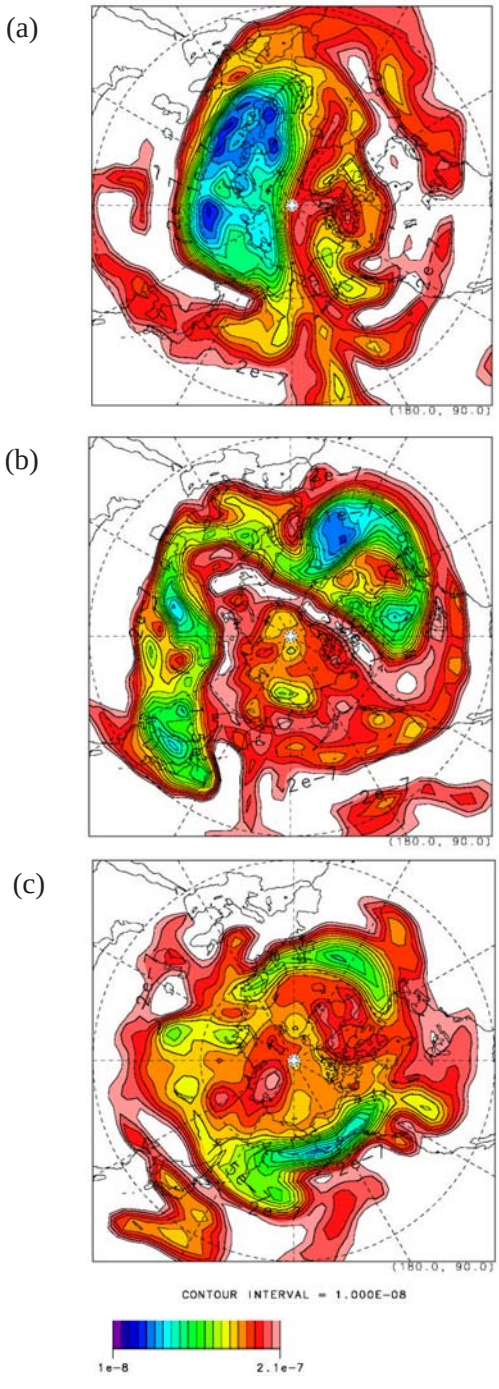
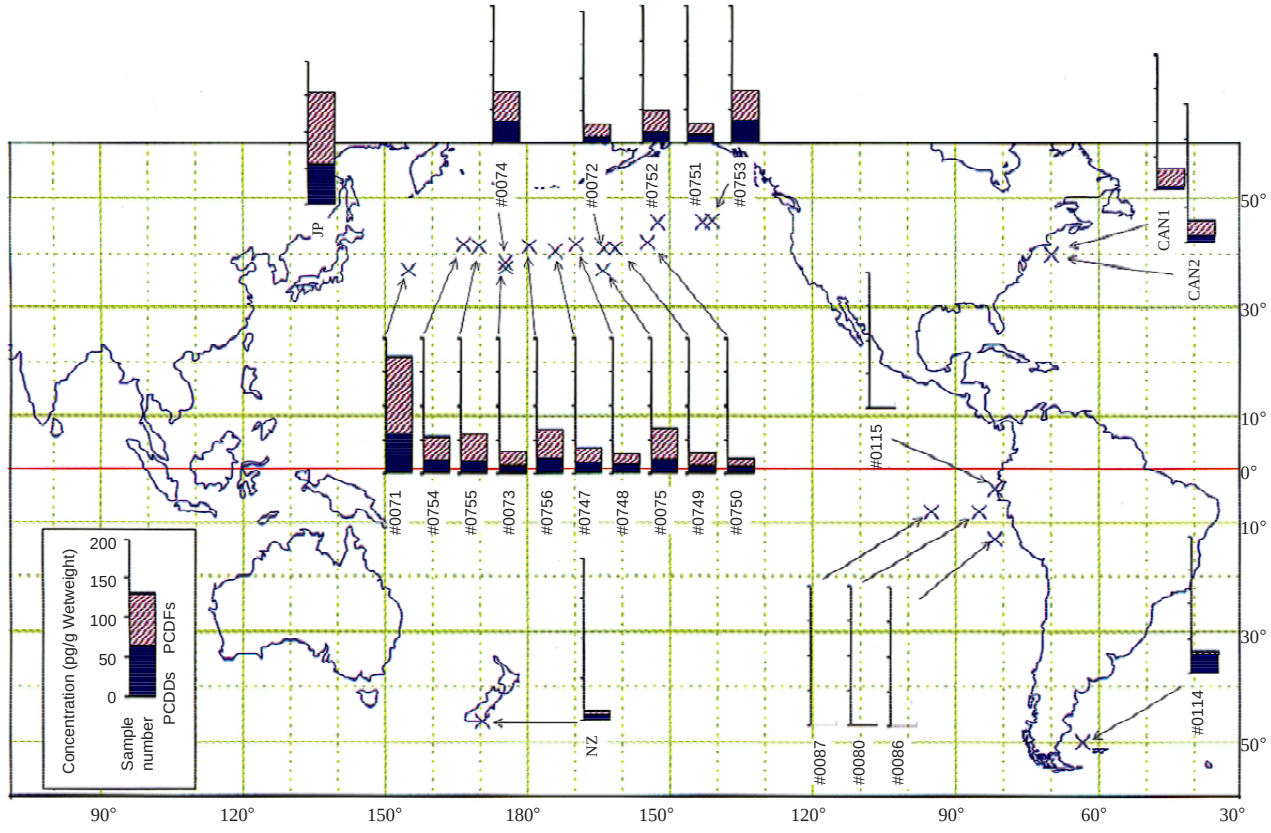


Fig.2
N_2O volume-mixing ratio distributions in the Arctic on (a) May 1, (b) 13, and (c) 28, 1997 at the 600 K isentrope calculated by the CCSR/NIES nudging CTM. The projection is stereographic, long 0˚E at top, long 90˚E at left, dashed circles at lat 30˚N and 60˚N. The color scale shows the volume-mixing ratios of N_2O. White indicates values beyond the range of the color scales.

heterogeneous reaction of formaldehyde with HNO_3, was reversibly taken up into the sulfuric acid solutions. This suggests that formic acid can serve as a good marker for the amount of HNO_3 converted into NO_x by the reaction of for maldehyde in/on sulfuricacid aerosols.

We are also developing a chemical transport model (CCSR/NIES nudging CTM) in parallel with the AGCM. This fiscal year, we introduced chemical reactions of bromine to investigate the role of bromine chemistry in stratospheric ozone loss. The CTM was also used to analyze the mixing processes of polar air into the mid-latitude atmosphere when the polar vortex breaks up over the polar circles. We found that N_2O can be tracked as a tracer of air masses (see Fig.2), and on the basis of this analysis, we succeeded in estimating the horizontal eddy diffusion coefficient in the high-latitude region over the Northern Hemisphere after the breakup of the polar vortex.

Endocrine Disrupters and Dioxin Research Project



Global monitoring of dioxin pollution using cuttlefish

The Endocrine Disrupters and Dioxin Research Project, which utilizes NIES's new Endocrine Disrupter Research Facility and Specific Research Facility for Dioxins, has conducted research on the following 4 themes: (1) development of measurement and bioassay methods, (2) evaluation of the current status of environmental pollution, (3) assessment of hazard and effects, and (4) development of countermeasures and integrated information technologies.

In FY 2001, major advances were achieved in the following areas:

1) Measurement of chemicals in water and human samples has been improved through the use of LC/NCI/MS and LC/ECD for non-volatile and thermally unstable compounds, and by the use of the GC/HRMS method for very low amounts of volatile compounds, such as 17β-estradiol and bisphenol-A.

2) *In vivo* and *in vitro* bioassays are important methods of screening chemicals for their endocrine disrupting properties. We developed 4 *in vitro* assays, including yeast 2-hybrid reporter-gene assays to assess estrogen, androgen, and thyroid hormone activity, as well as an ELISA-based assay for human estrogen receptor binding, which uses the fluorescence polarization method and cell proliferation using neuron cell lines. We assayed environmental samples with these methods to measure EDC residues in the environment.

In vivo assays using a freshwater fish (*medaka*) were used to examine vitellogenin synthesis and to conduct one-and-a-half-generation tests. Other *in vivo* assays included a thyroid hormone test with a frog (Xenopas) and reproduction and developmental toxicity tests with mice and rats.

3) A high-magnetic-field magnetic resonance imaging scanner (4.7 T MRI) was installed. Its application to functional NMR for brain imaging is to be initiated. To assess the effect of EDCs on the nervous system and behavior, we have observed the effects of bisphenol-A, ETU, and other positive controls on experimental animals.

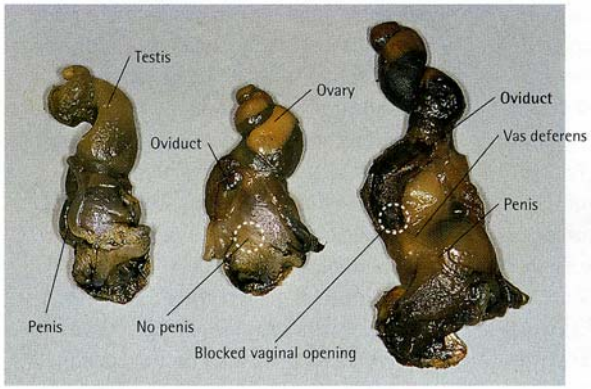
4) We administered dioxins to pregnant rats and observed the effects on the fetuses and infants to determine reproductive and developmental toxicity. A single dose of 50 ng TCDD /kg bw gave rise to decreased ano-genital distance in the newborns, suggesting that TCDD is strongly toxic to fetuses.

5) To determine the effect of EDCs on wildlife, we observed sea snails along the Japanese coast. Species of snail now face reproductive toxicity due to organo-tin compounds. (See example in Fig. 1).

We also examined fish and freshwater snails in Lake Kasumigaura and fish in the Tokyo Bay area for signs of feminization.

6) To reduce the emission of dioxins and to prevent secondary emission from to the environment, we studied methods of monitoring and decomposing dioxins. We successfully extracted dioxins from soil with high-temperature water, resulting in significant decomposition of dioxins (Fig. 2)

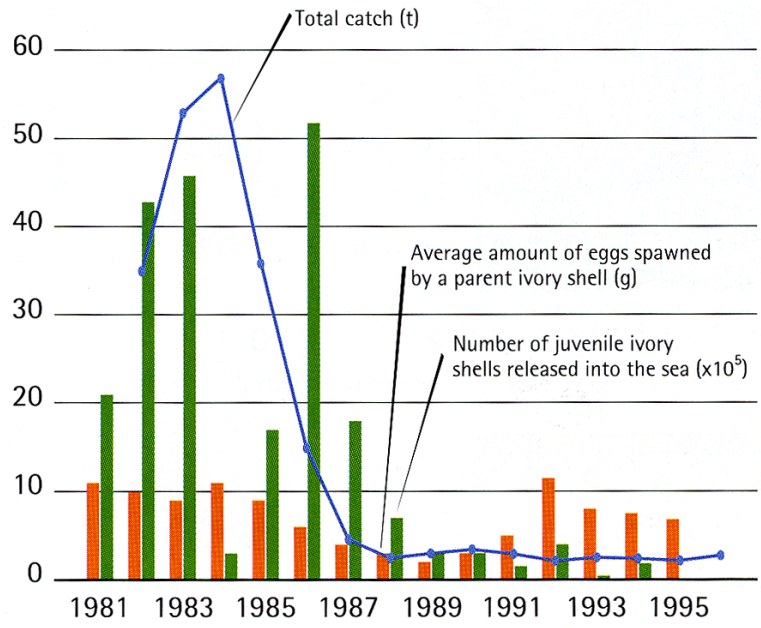
Fig. 1



Rock shell (with shell removed)

Rock shell(thais clavigera)

LEFT: male CENTER: female RIGHT: imposex-exhibiting female, which has male sexual organs, such as penis and vas deferens.
The specimens in the center and on the right were originally females. The center specimen is a normal female, while the one the right has both a penis and a vas deferens about the same size as the male's, but it is unable to spawn as its vaginal opening is blocked.
This phenomenon is known as imposex in snails, superimposition of male sexual organs on female snails.



Decrease in the total catch of the ivory shell snail fishery and difficulty of seed/seedling production (artificial hatching / incubation and release of juveniles)
The total catch of the ivory shell (Babylonia japonica) in one prefecture dropped dramatically starting in 1984.
Here imposex has been observed in the ivory shell since 1982.At hatcheries, the egg production by parent ivory shells decreased in the latter half of the 1980s.in line with this, the number of juvenile shells released to the sea also decreased, and the declining trend of the catch continued. This phenomenon is thought to have been brought about due to reproductive failure accompanied with imposex induced by organitin compounds from antifouling paints. Parent ivory shells were introduced from other prefectures starting in 1992 because natural egg production did not increase. Thanks to this measure it later increased.

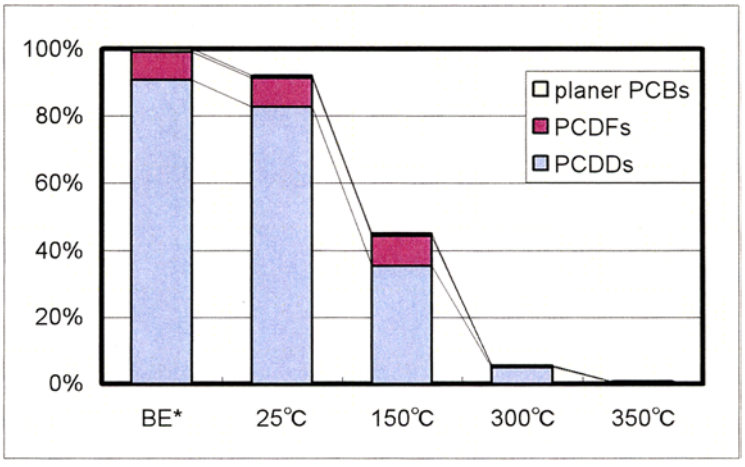


Fig. 2
Extraction of Dioxins in Soil by Hot Water.

Soil was extracted with hot water and residue of PCDD, PCDF and planer PCB was measured.

7) We developed an integrated information system that displays emission amounts and environmental levels of EDCs together with suspected phenomena related to endocrine disruption on a GIS (Fig. 3). The system is used for simulating environmental levels of chemicals based on their physico-chemical properties and environmental parameters. In addition to developing this system, we are preparing a database for EDCs to be available through the worldwide web.

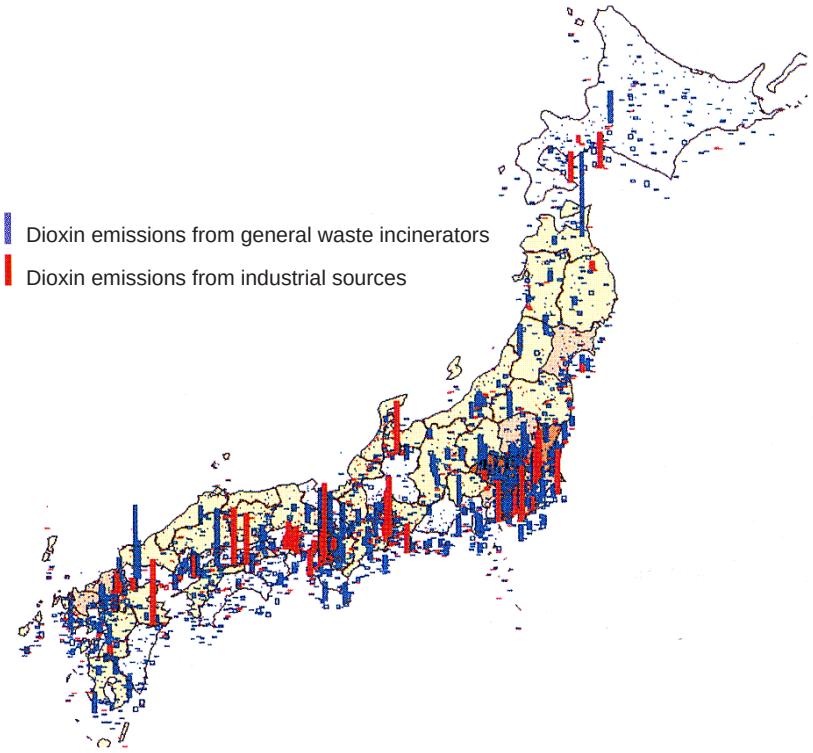
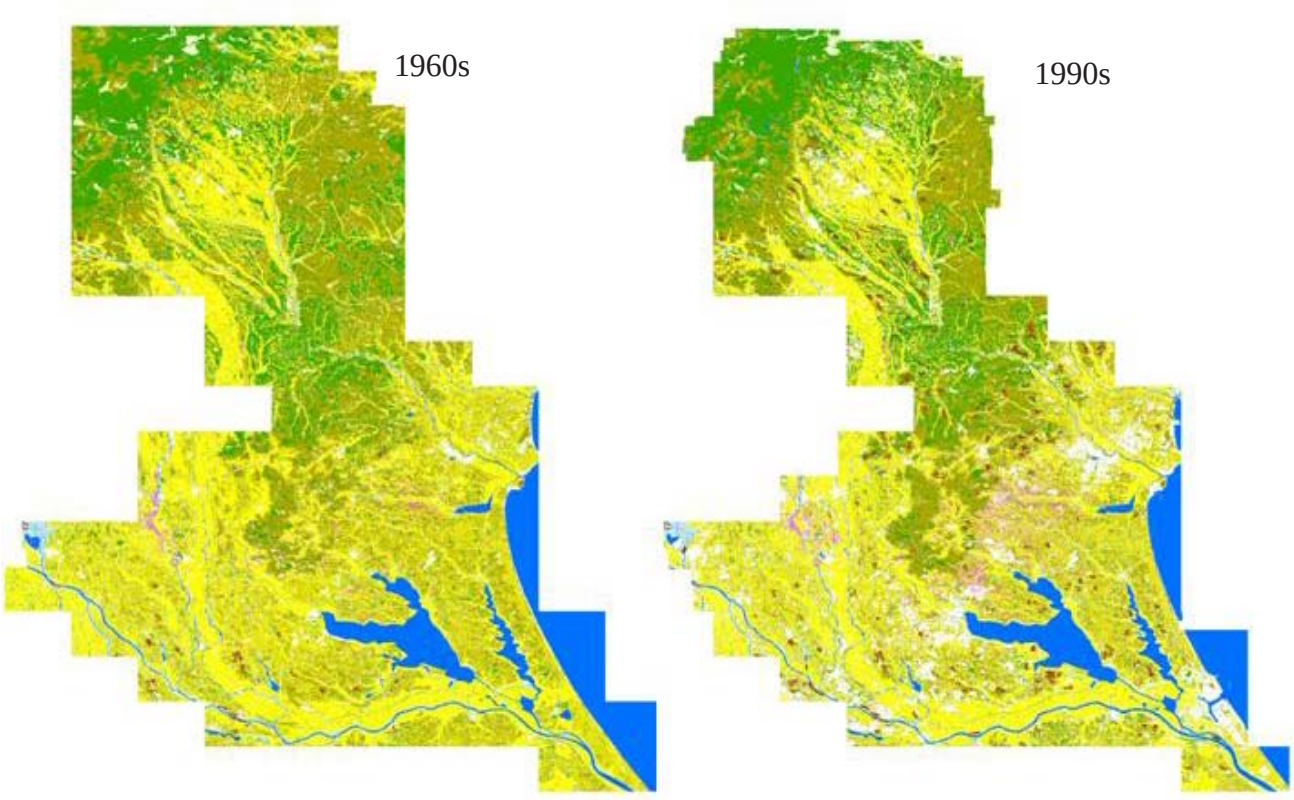


Fig. 3
Geographical information system (GIS) map of dioxin emissions and soil concentrations.

Biodiversity Conservation Research Project



Vegetation cover around Naka-river and Tone-river watershed in 1960s and 1990s.

The rapid growth of human activities is resulting in the degradation of habitats for wildlife and the loss of biological diversity. In addition, a new problem of ecological disruption from the incursion of invasive species and from genetically modified organisms has surfaced. In the Biodiversity Conservation Research Project, which comprises 5 research teams, we are developing methodologies to assess the changes in biodiversity on a variety of spatial scales, and are researching ecological disruption from invasive species and genetically modified organisms.

Wildlife Population Research Team

Because the need to prevent the extinction of wild species is increasing, the Population Biology Research Team is investigating the mechanisms that sustain populations, which are local groups of organisms of the same species. Every species actually exists as a network of populations. Populations often avoid extinction by having individuals emigrate to another population. One of the focuses of our research is to determine how populations are connected. Because populations often become isolated owing to the impact of human activity, such as habitat destruction and alteration, another research focus is to incorporate this knowledge into procedures to maintain population networks when planning land use and nature reserves (Fig.1).

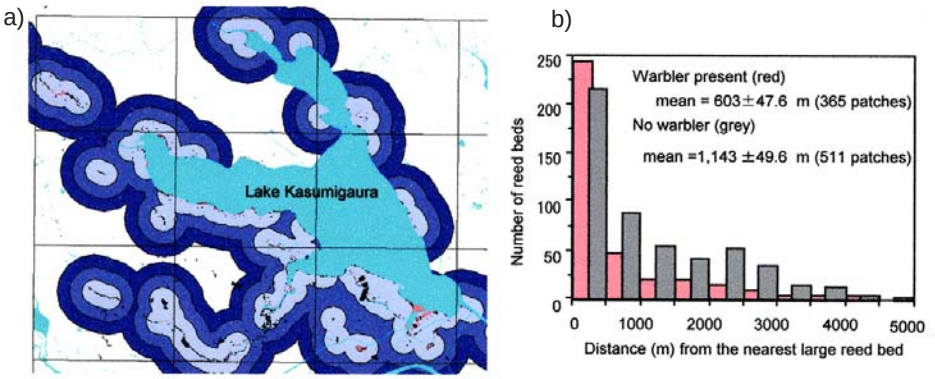


Fig. 1
a) Contour of the distance at intervals of 1km from the nearest large reed bed (> 1 ha) where the great reed warblers inhabit. Red patches show reed beds with warblers and black ones show those without them.
b) Comparison of the distance from the nearest large reed bed between reed beds with and without warblers. The warblers tend to colonize a reed bed closer to a large reed bed.

Ecological Landscape Research Team

This team explores the patterns of landscapes and their relation to species diversity in aquatic ecosystems. This year, we investigated the role of aquatic vegetation in maintaining biological diversity in a number of small agricultural ponds in the western part of Japan. We also examined the effects of habitat fragmentation on the richness of fish species in Hokkaido, the northernmost island of Japan.

During the summer of 2001, we sampled freshwater fishes at 67 sites in 15 drainage systems from a wide range of elevations; 29 of the 67 sites were located above dams blocking fish migration to those sites, while the remaining 38 sites were freely accessible from the sea. The richness of fish species declined sharply as the elevation of the sampling sites increased (Fig. 2), being well explained by a simple linear regression model. Detailed examination of the residuals of species richness from the regression line revealed that the sites above dams tended to be inhabited by fewer fish species than sites with no dams when compared within an overlapping elevation range ($p < 0.01$, U-test), indicating that the dams had driven some local fish populations to extinction. Loss of fish species richness due to damming has been pointed out for quite some time, but this research might be the first to quantitatively demonstrate the loss on such a large spatial scale.

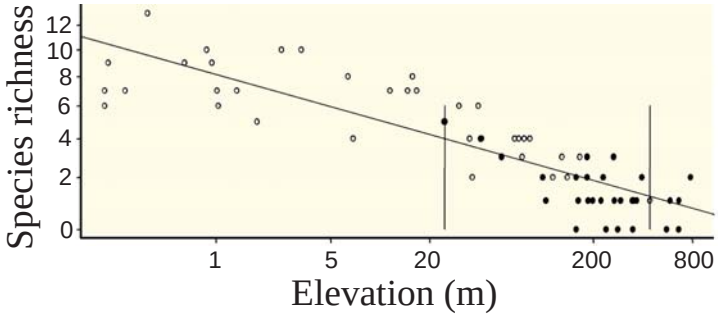


Fig. 2
Fish species richness decreased with increasing elevation, from about 11 species in estuaries to 1 species at 800 m above sea level (R^2 = 0.75, p < 0.01). Sites above dams (closed circles) were compared with those with no dams (open circles) within an overlapping elevation range (vertical lines).

Community Dynamics Research Team

To contribute to appropriate conservation practices for endangered plant species, we have been working on the interaction between population dynamics and genetic structure of clonal plants.

In 2001, we developed a prototype of a simulation model for clonal plants. The model is designed to recreate the dynamics of wild *Primula sieboldii* populations (Fig. 3). *P. sieboldii* is widely distributed throughout Japan; its native habitat is open, wet grasslands. *P. sieboldii* is rated as an endangered species, with the main threat to this species being from collectors and destruction of suitable habitats.

The simulation model also models the genetic structure and its dynamics; these are important because genetic factors such as inbreeding depression and loss of genetic diversity are suspected to accelerate extinction of local populations of endangered species.

P. sieboldii spreads vegetatively from underground buds. What is apparently a new plant sprouted from an underground bud is called a 'ramet'. The new ramet is genetically identical to its parental ramet. The present model incorporates both the vegetative expansion and recruitment from seeds.

P. sieboldii does not produce seeds without pollen from other plants. This phenomenon is recognized as a mechanism to avoid inbreeding. The model successfully reproduced the limited pollen flow and seed production when the population size of pollinating insects was small.

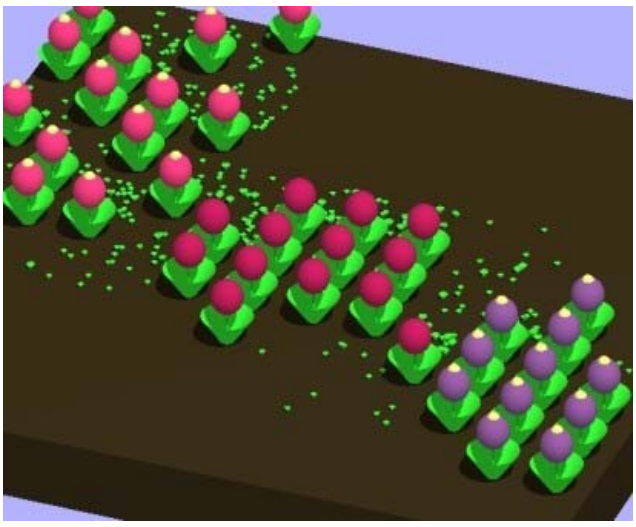


Fig. 3
An image generated by a simulation model of the population and genetic dynamics of the endangered perennial plant, *Primula sieboldii*. Different colors of the flowers indicate genetic differences.

Biological Invasion Research Team

Biological invasion is a serious cause of decreased biodiversity. We have been investigating the ecological impact posed by the commercial insect breeding industry. Since 1991, Japanese horticulturists have been importing *Bombus terrestris*, a bumblebee species from Europe, for pollinating greenhouse tomato plants. *B. terrestris* is such a competitive species that it would make a strong ecological impact on Japanese native species through competition for food and nest sites. Furthermore, *B. terrestris* has the potential to bring genetic introgression into the populations of native species. We established a genetic marker for differentiating the 2 species and their hybrids, and surveyed genetic variation in bumblebee populations in the field. The survey showed that hybrids have not yet increased in the field. The next serious impact comes from parasite invaders. We found the endoparasitic mite *Locastacarus buchneri* in commercially introduced colonies of *B. terrestris*. The average infestation rate of the colonies (n = 367) from the Netherlands and Belgium was 20%. By using a mitochondrial DNA marker we investigated the origin of the mite in commercial colonies and field populations of bumblebees. Comparing sequences of the mitochondrial DNA cytochrome oxidase subunit 1 gene from the mite showed that the haplotypes of the mites in the Japanese native bumblebees and the haplotypes of the mites in *B. terrestris* did not coincide; however, the mtDNA of mites detected in colonies of a Japanese native bee, *B. ignitus*, that were commercially produced in the Netherlands, possessed the same sequence as a European mite haplotype. These results indicated that transportation of bumblebee colonies causes overseas migration of parasitic mites of different origins (Fig. 4).

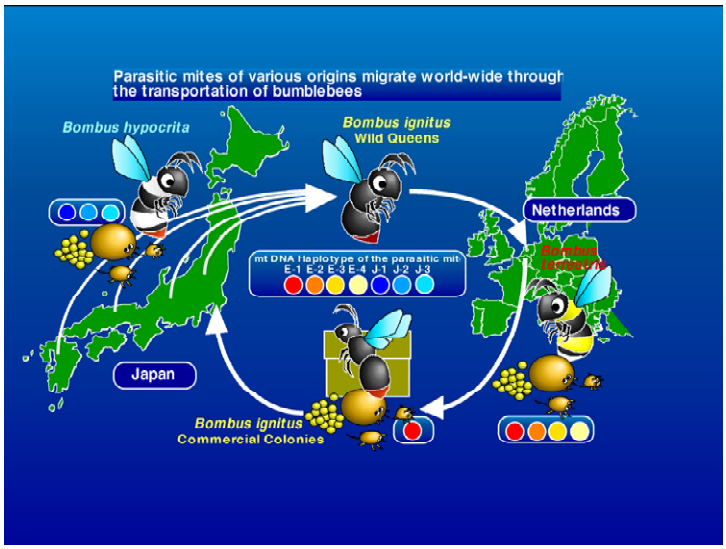


Fig. 4
Summary of tracheal mite migration caused by the transport of commercial bumblebee colonies. Mites of European genotypes enter Japan with *B. terrestris* colonies. European mites also enter Japan with the Japanese native species, *B. ignitus*, infested during mass colony production in the Netherlands. In the near future, other Japanese native bumblebees, *B. hypocrita sapporoensis* and *B. hypocrita hypocrita*, may be sent to the Netherlands for commercialization, carrying mites of Japanese genotypes into Europe.

Biotechnology Risk Assessment Team

As various genetically modified plants, so-called “transgenic plants”, are generated and are utilized for a variety of purposes, their potential effects on the natural environment have become a matter of increasing public concern. It is important to monitor transgenic plants and their effects in the natural environment; therefore, a satisfactory method to evaluate such effects needs to be established. A marker enabling us to easily discriminate transgenic plants from natural plants is needed for such a purpose. We investigated the feasibility of 2 genes, a homeobox gene causing a foliar malformation and a gene encoding a green fluorescent protein (GFP), for such a marker

of transgenic plants. We found that the former was superior to the latter in the ease of detection, but was inferior in its side effects on the host plants (Fig. 5).

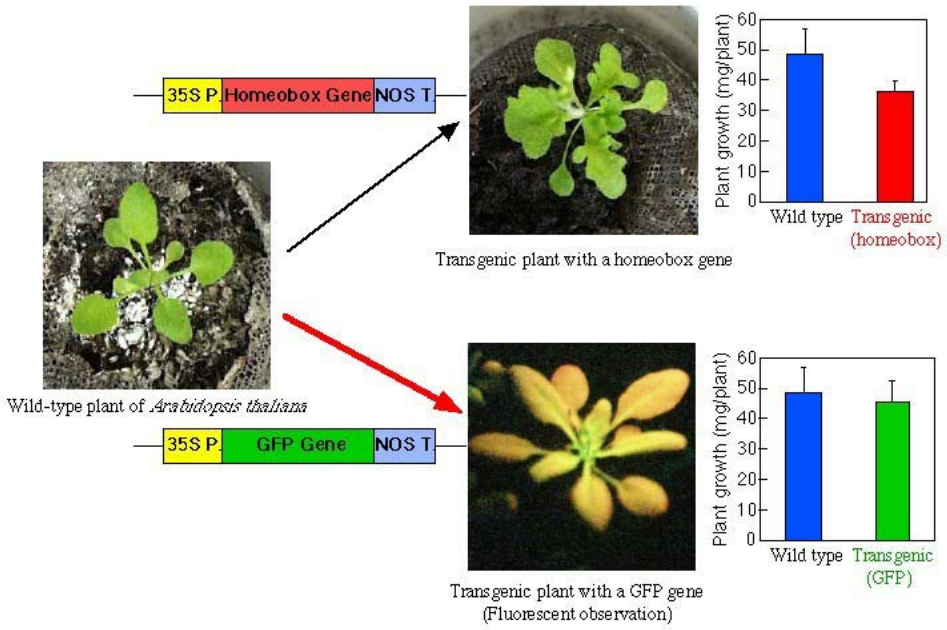


Fig. 5
Transgenic plants with marker genes. The phenotypes conferred by the marker genes and their effects on growth of host plants are shown in the right half of the figure.

To monitor the fate of genetically engineered microorganisms introduced into the environment, we constructed genetically engineered soil bacteria possessing a mercury-resistance operon as a specific marker gene. This marker was a useful tool in that it was stably maintained in the host cells and could be easily detected. When *Pseudomonas putida* PpY/pSR134 containing the marker gene was introduced into an aquatic microcosm, we observed that this bacterium decreased more rapidly in an illuminated system than in a dark system. In response to unsuitable environmental conditions, bacteria change their metabolic and cellular components and enter a non-growing stage (VBNC; viable but non-culturable). To confirm this phenomenon, we isolated 5 strains from a municipal sewage disposal plant, and stressed the strains by chlorinating. Four of the strains became VBNC, suggesting that VBNC might be a common stage. Therefore, a new system for assessing whether bacteria are alive or dead will be necessary.

Watershed Environments and Management Research Project

Ground Truth in Ecological Station in Fukang

Asian Environmental Monitoring Network by NIES and CAS

EOS-TERRA/MODIS Receiving Station in Urumqi (NIES)

To support sustainable development in river basins in East Asia, our primary attention focuses on the regional water cycles that govern material transport and ecological functioning. We have employed 3 methods to scientifically understand water cycles in river basins: 1) direct measurement, 2) remote sensing (satellite monitoring), and 3) mathematical simulations based on observed physical parameters. Below are brief details of 3representative studies:

(1) The land–atmosphere interaction plays an important role in the water cycle. Because the land–atmosphere interaction depends on the terrestrial vegetation, we have to construct a database on the soil–plant–atmosphere interactions for various terrestrial ecosystems. In fiscal year 2001, NIES constructed observation stations in China to measure the soil–plant–atmosphere interactions (Fig. 1). Many parameters, such as temperature, solar radiation, precipitation, and heat flux, were observed.

(2) NIES built a receiving station in Urumqi to receive data from the high-performance global observation sensor MODIS installed on the EOS-TERRA satellite, while the Chinese Academy of Sciences built a receiving and data-processing center in Beijing. Consequently, we constructed an Asian environmental observation network with these 2 stations at the core. Through this monitoring network, we can monitor many river basin parameters, such as land use, vegetation distribution, land surface temperature, snow accumulation, rainfall distribution, soil water content, heat energy, land-use productivity, and agricultural product yield.

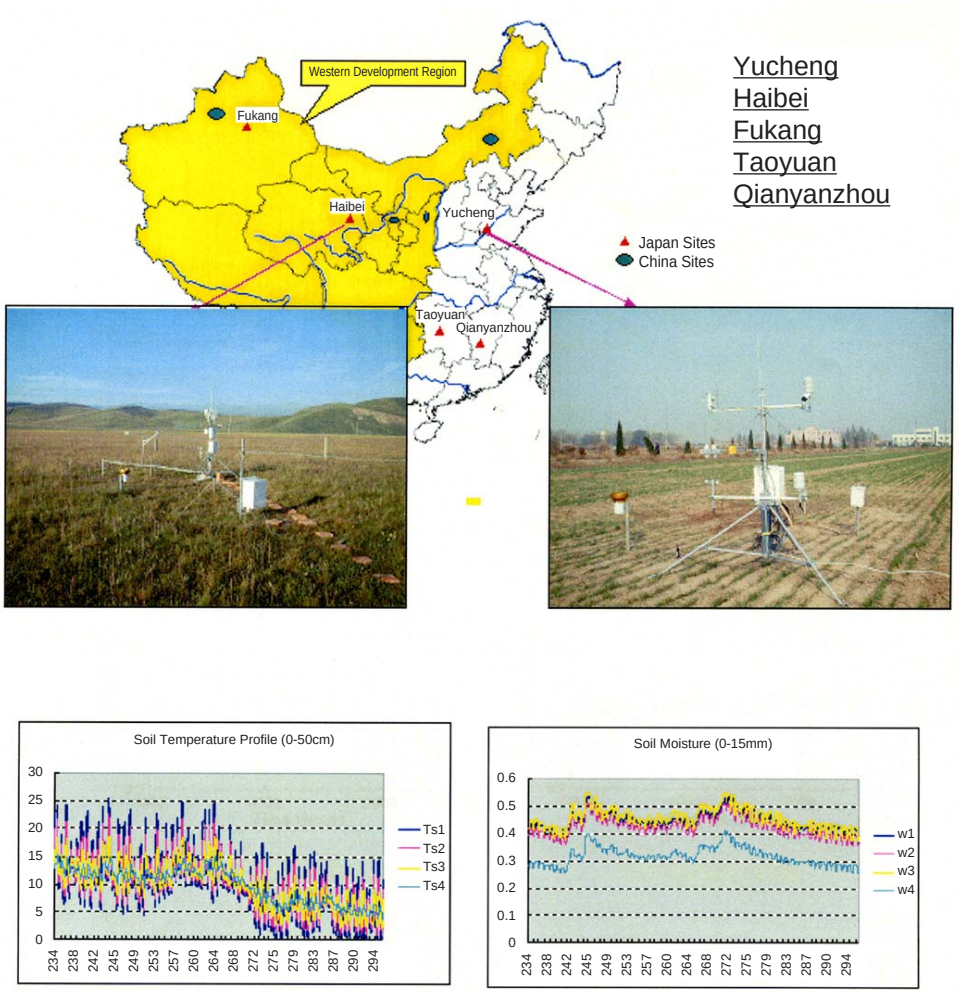


Fig. 1
Observation in several kinds of terrestrial ecosystems.

(3) We developed a water and heat energy circulation model with a 3-dimensional structure. This model consists of 4 sub-models: a land–atmosphere interaction model, a model of saturated and unsaturated flows of soil water in the vadose zone, a groundwater flow model, and a dynamic flow model along the river network in the watershed. We applied this model to the hydrological cycle of the Kushiro Mires in Hokkaido; the comparison between the measured soil surface moisture and the simulated one (Fig. 2) verifies the proposed model and indicates its applicability.

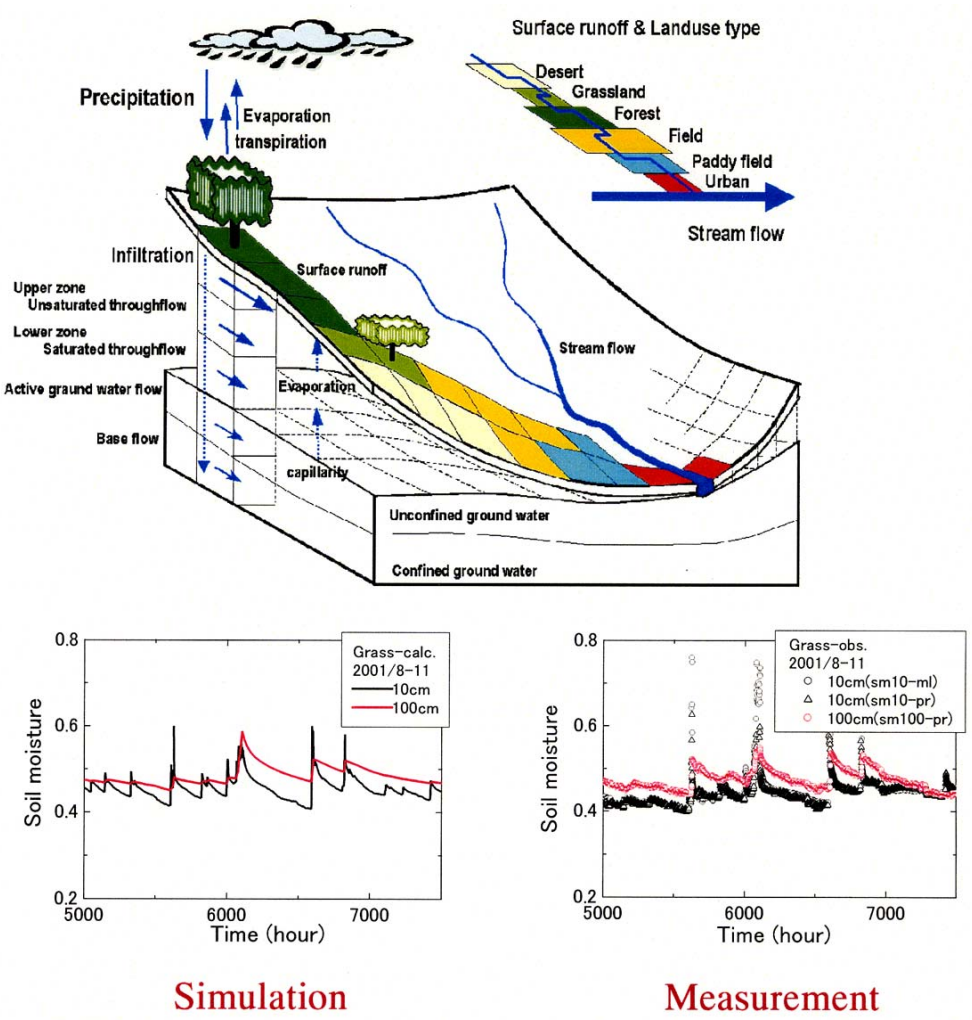


Fig. 2
Measured and Simulated Soil Moisture on Grassland in Kushiro River Basin, Japan.

PM2.5 & DEP Research Project

The environmental fate and risk assessment of airborne particulate matter including $PM_{2.5}$ and diesel exhaust particles (DEP).

Air pollution from vehicle emissions remains a serious problem in urban areas. The $PM_{2.5}$ and DEP Research Project Group is carrying out investigations to better understand the characteristics of the pollutant sources as well as the environmental fate of fine particulate matter and its effects on human health.

Traffic Pollution Control Research Team

The Traffic Pollution Control Research Team has mainly been conducting emission inventories and examining strategies for reducing particulate matter (PM) and diesel exhaust particles (DEP). These studies have included measurements of automotive exhausts on a chassis dynamometer, a field survey near a trunk road, compilation of emission inventories, a review of PM and DEP countermeasures, and the development of a GIS-based information system for assessing the effectiveness of policy measures. In fiscal year 2001, in cooperation with another grant-funded research project assessing on-board measurements of automotive exhausts, we measured particulate and gaseous pollutants from several diesel-engine vehicles on a chassis dynamometer, which was only recently installed at NIES. In addition, we conducted a field survey focusing on the measurement of DEP at the side of a trunk road heavily used by heavy-duty trucks. A large number of ultra-fine particles were observed during weekday mornings. In another study, we examined a GIS-based emission inventory system, which had been developed in a previous research project on VOCs, to determine whether further improvements could be made. We found that improvements in the classification of vehicle type and in the temporal changes of traffic flows are crucial for accurately reflecting specific regional and local factors. To assess the effectiveness of various policy measures, we also designed the framework of an integrated system consisting of models to assess traffic flows, emissions, dispersion, and exposure to DEP and PM (Fig.1).

Fig. 1
Chassis dynamometer for automotive exhaust measurements.

Urban Air Quality Research Team

The Urban Air Quality Research Team has been investigating the relationships between changes in the relative importance of various air pollution sources and the spatial and temporal distributions of urban air pollution. To clarify the behavior of airborne particulates—such as $PM_{2.5}$ and DEP—and combinations of gaseous air pollutants, we have been conducting wind tunnel experiments, field observations, and computer simulations. In fiscal year 2001, we performed a series of thermally stratified wind tunnel studies, mainly focusing on air pollution distribution in street canyons, to understand the dynamic behavior of air pollution near roadsides. Also, on the basis of 3-dimensional field observations and by using the Models-3/CMAQ model, we continued our study into the reasons behind the observed trend for ground level ozone to increase over wide areas of Japan. The model showed that international transport of air pollutants affected the levels of air pollution and urban air quality in Japan. Taking this wider-scale air pollution into consideration, we conducted studies on urban air pollution in Tokyo and Osaka.

Aerosol Measurement Research Team

The Aerosol Measurement Research Team has been investigating new technologies to measure particulates and gaseous pollutants. To do this, a high spatial and temporal resolution monitoring system is being developed and tests are being conducted on the applicability of a β-ray absorption method to measure $PM_{2.5}$. In fiscal year 2001, as the initial part of the program for developing the high spatial and temporal resolution monitoring system, multi-location measurement of NO_2 and particulate matter was carried out in a city with heavy traffic. We found high spatial variability, thus demonstrating the necessity of such high-density monitoring. In addition, to examine the applicability of the β-ray absorption method to measuring $PM_{2.5}$, we compared this method with other commonly used methods, such as TEOM and gravimetric filtration methods.

Epidemiology and Exposure Assessment Research Team

The Epidemiology and Exposure Assessment Research Team is researching the extent of human exposure to $PM_{2.5}$ and DEP. Assessment of exposure is an integral and essential component of environmental epidemiology, risk assessment, and risk management. The methodologies used to assess exposure employ various direct and indirect techniques, such as personal monitoring and modeling. We are currently investigating an exposure modeling approach for airborne particulate matter (PM) based on microenvironmental concentrations and time-activity data. In fiscal year 2001, in cooperation with the Traffic Pollution Control Research Team and the Urban Air Quality Research Team, we conducted a basic study to establish an exposure assessment system using a geographical information system (GIS). This system can calculate the level of exposure in the population according to the level of pollution concentration, calculated from a diffusion model using concentrations of air pollution emitted from roads and other sources, superimposed on the population distribution. The first phase model covers macro estimates of population exposure for risk assessment and management. The components of the model can include concentrations of PM in typical microenvironments (homes, roadsides, vehicles, etc.) where people spend time, the amount of time spent there, and equations for the relationships between indoor and outdoor concentrations. We also analyzed data on vital statistics in various

regions, considering the statistical correlation between exposure levels and mortality rates (Fig.2).

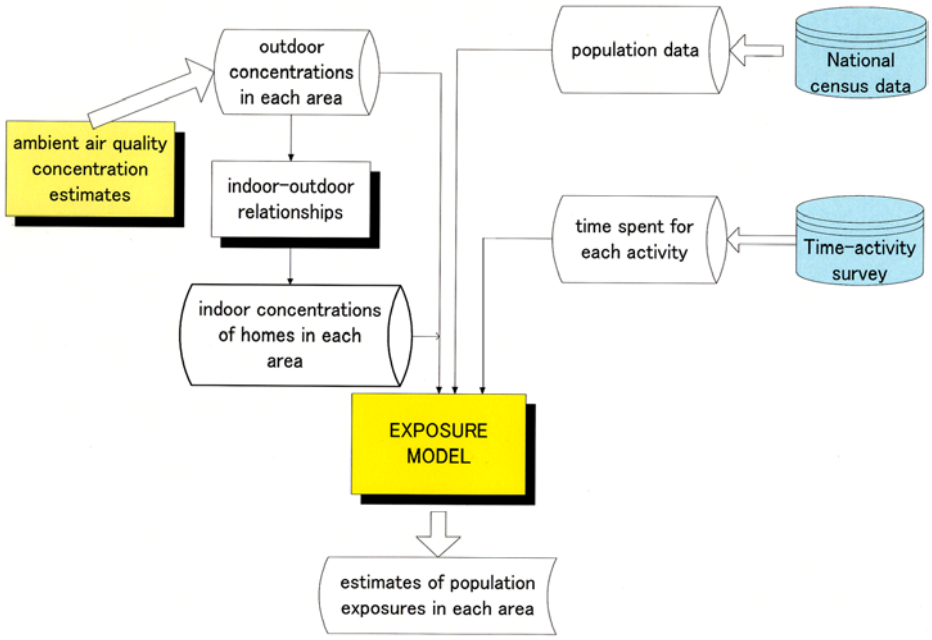


Fig. 2
Basic components of an exposure model.

Toxicity and Impact Assessment Research Team

The Toxicity and Impact Assessment Research Team researches the toxicity of DEP and $PM_{2.5}$. Epidemiological studies have shown an association between concentrations of $PM_{2.5}$ and the morbidity and mortality rates of populations with preexisting cardiopulmonary disease. We designed toxicological studies to clarify the effects of diesel exhaust (DE) and $PM_{2.5}$ on respiratory, cardiac, and immunological function in rats.

We have conducted animal experiments on long-term exposure to DE exhaust. In addition, we have conducted comprehensive and systematic experiments on individual animal organs, such as lungs and hearts, to clarify the impacts of diesel emissions on respiratory and circulatory organs. To elucidate the effects of inhaled DE on cardiac function,we obtained electrocardiograms (ECGs) were measured from rats that were exposed to DE at concentrations of 0, 0.3, 1.0, or 3.0 mg DEP/m^3 for 12 hours per day, every day for 12 months. We observed an increase in irregular ECG potentials and arrhythmias in the rats exposed to DE for 9 or 12 months. Functional abnormalities among the rats exposed to 3.0 mg/m^3 for 12 months included continuous atrioventricular block and premature ventricular contraction. Compared with that of the control animals, heart rate was significantly increased in rats exposed to 0.3 mg/m^3 for 9 months and in the rats exposed to 0.3 or 3.0 mg/m^3 for 12 months. Our results suggest that inhalation of DE causes arrhythmias and changes in cardiac function.

We also examined the effects of $PM_{2.5}$ or DEP on model animals with preexisting cardiopulmonary disease. Spontaneously hypertensive(SH) rats were instilled with

$PM_{2.5}$ or DEP extract intratracheally and measured their pulmonary function and ECGs (Fig. 3). The R-R intervals, the low frequency power spectrum (LF), and the high frequency power spectrum (HF) were analyzed from the ECG. Lung resistance increased in the SH rats. In the SH rats, the R-R interval and HF increased with administration of $PM_{2.5}$, but the LF/HF ratio did not change. Our results suggest that $PM_{2.5}$ increases parasympathetic nervous activity in SH rats, and populations with preexisting hypertension could be more susceptible to $PM_{2.5}$.

We also determined the effects of DEP, a major contributor to particulate pollutants, on lung injury related to bacterial infection in mice. Intratracheal instillation of DEP dramatically enhanced lung injury related to endotoxins from gram-negative bacteria; lung injury was characterized by neutrophil sequestration, interstitial edema, and alveolar hemorrhage. In the presence of endotoxins, DEP further increased the lung expression of ICAM-1, IL-1β, macrophage chemoattractant protein-1, keratinocyte chemoattractant, and particularly macrophage inflammatory protein-1α. These results provide the first experimental evidence that DEP enhance lung injury related to bacterial infection (Fig.3).

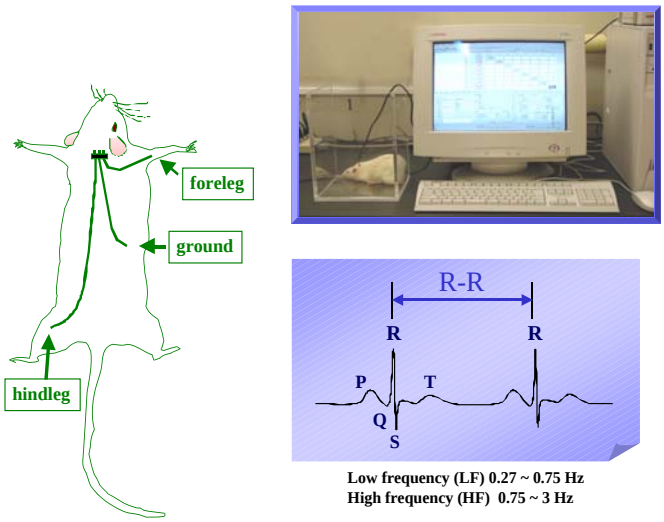


Fig. 3
Measurement of electrocardiogram.

Research Center for Material Cycles and Waste Management

Assessment Tools and Information for Supporting a Sustainable Material Cycling Society

As a first step toward establishing a material cycling society, it is necessary to properly understand the present situation and problems with the flow of resources, products, and waste. We are developing 4 analytical tools: 1) methods to describe and analyze the flow of materials, including recycled resources, that are consistent with economic statistics, and methods by which to accurately represent the level of recycling; 2) methods to comprehensively assess the reduction in environmental load resulting from increased use of recycled resources; 3) methods to support the establishment of recycling systems tailored to unique regional characteristics; and 4) methods to assess the safety of products that incorporate recycled resources. The reason for developing and using these tools is to decrease the input/output flow—the gathering of resources and their ultimate release into the environment—by increasing the material cycling flow (Fig. 1).

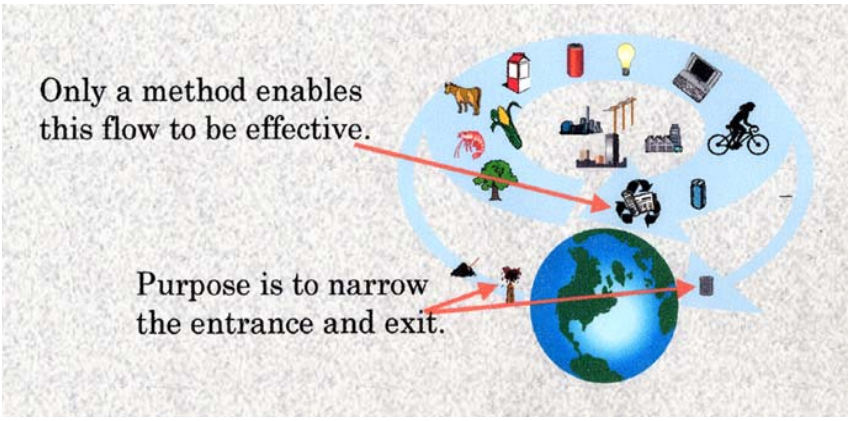


Fig. 1
Concept for Establishment of Material Cycling Society.

We are also trying to grasp the overall picture of the structure of material cycles within industry by integrating input—output tables, which show inter-industry transactions, with a method of material flow analysis. The index currently used to determine "Recycling Rate" has a different definition for each subject, and although some of these definitions focus on an individual product or material, the index of "recycling level throughout society" is not sufficiently confined. We propose 6 new indexes: 1) direct material input (DMI); 2) direct processed output (DPO); 3) utilization rate of recycled products; 4) resource recovery rate from used products; 5) utilization rate of materials; and 6) lifespan of materials. If we provide the public with these indexes to aid in planning, implementing, and assessing achievement of the various measures necessary to make the shift to a material cycling society, we expect that all of the major material objects used in this society will eventually embody an effective "Recycled" component. We believe that this research will contribute to advancing the establishment of a material cycling society.

Material Recycling, Waste Treatment, and Disposal Technologies

Within this sub-theme we aim to develop technologies and systems for resource recovery, appropriate waste treatment, and disposal, as well as methods to assess their efficacy. These will be key technologies in a material cycling society. So far we have developed the following: 1) a method to evaluate thermal treatment systems suitable for a material cycles-oriented society; 2) technology necessary to maintain final disposal sites and increase their capacity; 3) methods to characterize the environmental impact of final disposal sites located next to the sea; 4) indexes to measure the level of physico chemical stability in disposal sites and to diagnose the necessity for site improvement, and methods of assessing the efficacy of technologies to promote and improve levels of stabilization in disposal sites; and 5) methodologies for determining the generation, supply-and-demand, and material flows of organic wastes and the technological developments necessary for resource recovery.

We need to develop and use technologies that reduce the environmental load during the processes of recycling and disposal. To develop such technologies, it is important to understand the physicochemical properties of the target substances. We are developing a model for measuring and estimating physicochemical parameters. Our research has determined that the UNIFAC model is useful for estimating the physicochemical constants necessary to forecast the behavior of dioxins in the environment. Regarding methods to promote stability in final disposal sites and risk reduction technologies, we developed a simple and easy procedure to measure the potential hydrogen sulfide (H_2S) emission from waste and found several specific properties for the control of H_2S. We also developed a method to detect methane gas emission points in landfill sites by using a thermograph to assess the stability of the final disposal site, and a simple method to estimate ground-level gas flux by using ground-level temperature distribution profiles (Fig. 2).

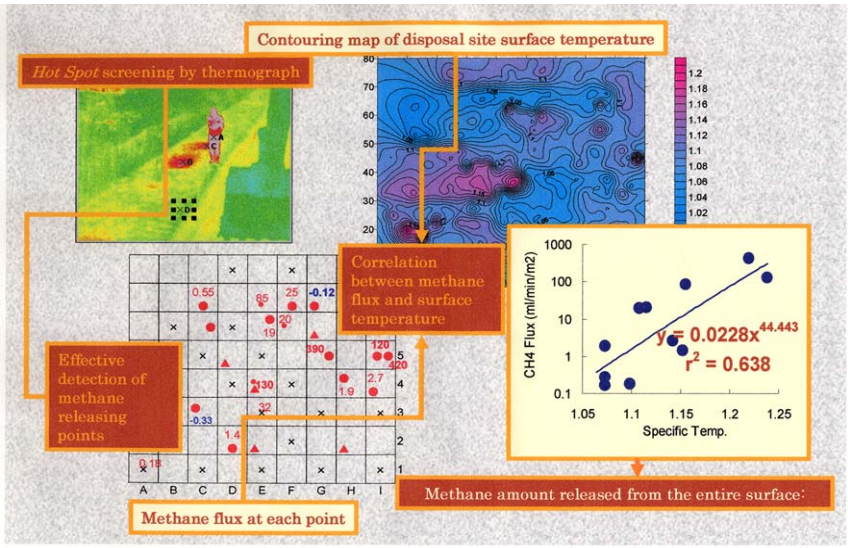


Fig. 2
Use of Methane Flux and Thermograph for Landfill Site.

Integrated Risk Control of Material Cycles and Waste Management

To comprehensively control risks of hazardous chemical substances contained within recycled resources and waste, we are developing: 1) an integrated detection method using a bioassay; 2) methods for analyzing and controlling organic brominated compounds; 3) a method for the systematic detection of non-volatile chemicals; and 4) a method to decompose waste containing organic chlorine compounds. These developments aim to contribute to securing safety in the process of reutilization, intermediate treatment, and final disposal, and to increase the quantity of recycled resources used.

We are developing a monitoring method that uses bioassay techniques to enable integrated and easy detection of hazardous substances contained within recycled resources and waste, and in the related soil, water, and emission gases. In 2001, we used an Ah-receptor-binding assay to obtain various data (bio-TEF(Toxicity Equivalency Factor)) related to standard substances, such as dioxins and coplanar PCBs. We found that those data correlated well with the WHO-TEF. We examined various methods of fractionating fly ash and waste oil and found that the bioassay method avoided the over-assessment of PAHs that occurs with thermal reflux treatment of sulfate silica gel and the interruptive influence of non-dioxin-like PCBs that occurs with an activated carbon column. Bioassay methods have the advantage of being able to directly detect the toxicity of hazardous substances, and we expect that they will play an increasingly important role alongside chemical analysis in material cycling and waste management in the future (Fig. 3).

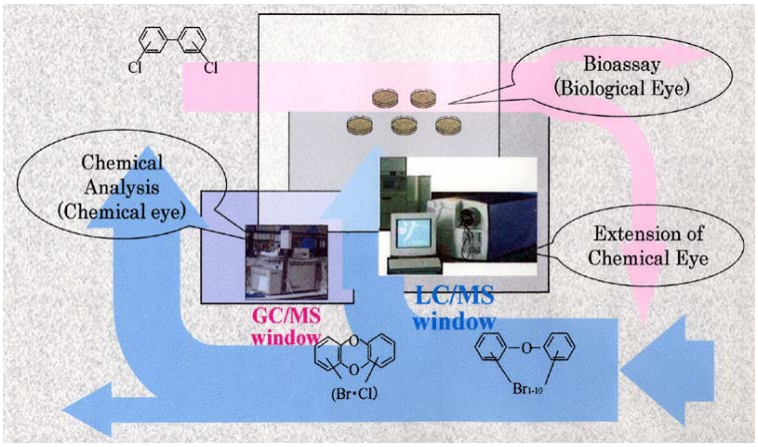


Fig. 3
Use of Bioassay and Extension of Chemical Analysis.

Technology and Systems for Low-Environmental-Load Resource Recovery and Treatment of Liquid Waste

Development of 3R measures (Reduce, Reuse, Recycle) for liquid waste, such as human waste and domestic wastewater, are also important. To effectively carry liquid waste treatment forward into a material cycling society, it will be important to develop a treatment system and technology oriented toward low environment loads and resource recovery by using eco-engineering incorporating bioengineering into soil and wetland ecosystems.

We are using our bio- and eco-engineering research facilities to conduct experimental studies to solve problems related to the development and utilization of such technologies for liquid waste treatment, especially from the viewpoint of developing countries. Research and development issues are: 1) processes of nitrogen and phosphorus removal and recovery; 2) methods of simplifying the technology used to manage purification systems; 3) a purification system technology suitable for situations in developing countries; 4) development of technological systems combining bio- and eco-engineering and physicochemical treatments; and 5) optimized management methods for environmental improvement systems tailored to individual regional characteristics.

We obtained laboratory data on phosphorus recovery, including characteristics of adsorption and desorption, by using a phosphorus adsorption carrier based on zirconium-ferrite compounds to establish a technology that reduces the amount of phosphorus released and enables the recovery of phosphorous from septic tanks. We experimented with the recovery of phosphorus from a real septic tank, and performed experimental studies to determine the operational conditions for optimal recovery. We thus clarified key operational conditions for phosphorus collection.

Research Center for Environmental Risk

Chronic exposure to arsenic causes melanosis, hyperkeratosis, and tumors.

Children in the arsenism-endemic area in China (Guizhou Province)

This Center promotes research projects on environmental risk assessment. Currently, there are projects covering 7 themes: (1) development of an exposure assessment methodology that considers for variability, (2) development of a methodology to assess exposure based on limited information, (3) development of a methodology to assess health risks that considers susceptibility to chemical substances, (4) development of bioassay systems for environmental monitoring, (5) development of a methodology to assess health risks from concurrent exposure to various chemical substances, (6) development of a methodology to assess ecological risk on the basis of toxicities to individual organisms, and (7) development of a methodology for communication of risks. Brief accounts of some important results in the research projects in 2002 are given below.

Development of an exposure assessment methodology that considers for variability

Practical assessment of exposure often depends on averages or assumptions of extreme cases to consider unexpected variability with sufficient safety margins. Major sources of variability in assessment of exposure include fluctuations in environmental levels due to the effects of countermeasures and variation in exposure levels over a geographical scale. Another possible factor affecting assessment of exposure is the different sensitivity at each life stage of the target humans or other biota. It is necessary to consider these variabilities for more detailed exposure assessment. Thus, this topic is development of an assessment methodology that considers variability in the information. Our first priority was to develop an assessment methodology that considers variability in geographical information. In fiscal year 2001, we developed databases from river water quality models on a geographical information system (GIS) and other relevant geographical and hydrological data. This system will form the basis for an assessment methodology that considers geographical variability. We developed 3 types of river models—dilution, dilution and decay, and compartmental models. Using the models, we performed a case study of selected pesticides in the Shinano river basin area (Fig. 1).

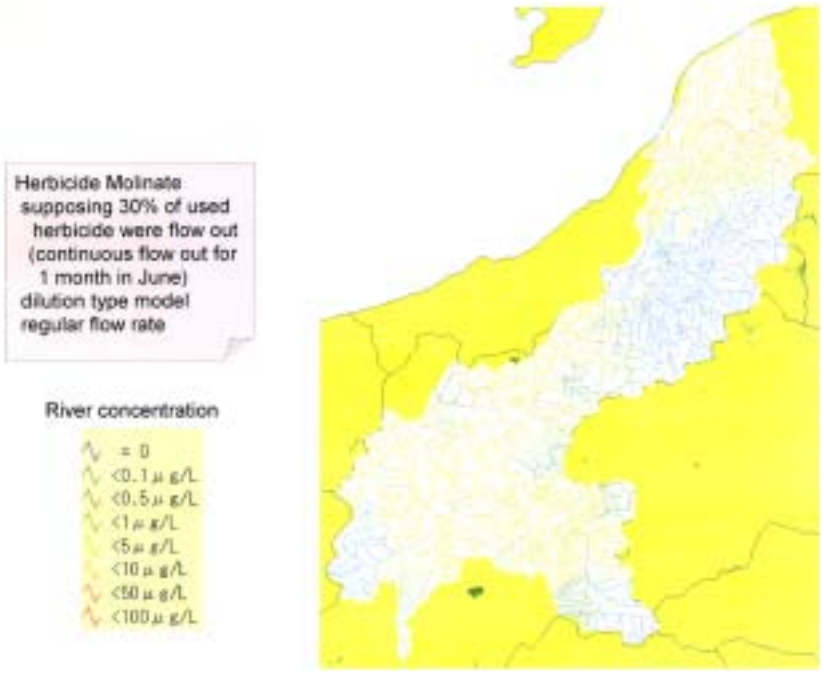


Fig. 1
Case study on Shinano river basin area using the developed river water quality model on GIS system.

Development of a methodology to assess health risk that considers susceptibility

There are 2 studies in this sub theme. One is risk assessment of chronic arsenic exposure in China. We determined concentrations and speciation of arsenic in samples of coal, urine, hair, and water collected in mid-September 2001 from the village of Changqing (Xing Ren County, Guizhou Province, PR China), an area where airborne arsenism is endemic (Fig. 2). Although the coal was found to contain 56.3 ± 42.5 mg As kg^{-1}, which was lower than that reported for coal samples collected at other times from the same province, more than 30% of the study subjects from Changqing (15 females, age 48.8 ± 14.9 years; 23 males, age 37.7 ± 14.4 years) showed clear symptoms of arsenosis, such as keratosis and tumors. The urinary arsenic concentration in the study subjects was 71.4 ± 37.1 μg As g^{-1} creatinine, whereas the corresponding control value (measured in inhabitants of a non-polluted area in Japan) was 41.6 ± 12.1. The concentration of arsenic in the hair of the study subjects was 8.0 ± 8.2 mg kg^{-1}. The arsenic concentration in water was much lower than the guidelines (2.3 ± 1.9 μg L^{-1}) and therefore did not contribute to the total arsenic exposure. The arsenic concentration in urine was higher for females than for males, but the difference was statistically insignificant (p = 0.19). On the other hand, there was negligible difference between the arsenic concentrations in hair from females and males (p = 0.8). Females were found to have higher levels of dimethylarsinic acid (DMA) but lower levels of As (III) and monomethylarsonic acid (MMA) in their urine. There was a strong positive correlation between the arsenic concentrations in hair and urine (R^2 = 0.601). The chemical speciation of arsenic in the urine of inhabitants of this polluted area of China is different from that in inhabitants of the non-polluted area in Japan; this difference corresponds to the intake route (Fig. 2).

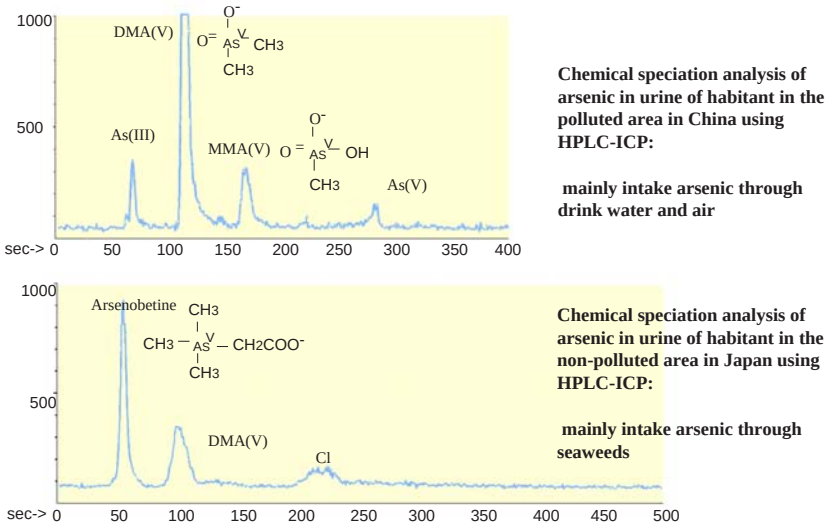


Fig. 2
Chemical speciation analysis of arsenic in urine of habitants in the polluted area in China with Japan non-polluted area using HPLC-ICP.

The second study in this sub theme is the analysis of polymorphism to improve the evaluation of health risks. When calculating an uncertainty factor for evaluating the health risks of hazardous chemicals, 3 factors are commonly taken into account. They are interindividual differences, interspecies differences, and the seriousness of patho-physiological findings in animal experiments. However, these 3 factors are not always sufficient, because some genetically different populations are highly sensitive to certain chemicals. To investigate genetic differences responsible for

susceptibility to chemicals, a human polymorphism study is underway. Approximately 1200 workers in the town of Kiyotake, Miyazaki Province, gave us their informed consent to collect samples of their blood for DNA extraction. DNA samples were prepared using a commercial kit for future analysis of human polymorphism.

Development of bioassay systems for environmental monitoring

The cost of managing the risk of exposure to environmental chemicals has been steadily rising as the number of chemical substances used in industry increases. Hazardous effects of chemical products have been estimated by test methods that use whole animals, but the high cost makes these animal-based testing methods inefficient for evaluating the environmental hazards of chemical substances. To reduce the cost of risk management, we are developing *in vitro* bioassay methods for environmental monitoring of hazardous chemical substances. To estimate the reliability of *in vitro* bioassay systems for assessing health risk, we plan to clarify how the mutagenicity of chemicals as evaluated by *in vitro* bioassay methods corresponds to mutation frequency induced in the body. This year, we validated a point mutation detection system that uses zebrafish.(Fig. 3) Using this system, we identified possible types of point mutation induced by various chemical substances .

Fig. 3
Zebrafish

Development of a methodology to assess ecological risk on the basis of toxicities to individual organisms

In Japan, risk management from the viewpoint of ecological risk is behind that of many countries. In order to introduce a system of ecological risk management, we must establish methodologies to quantitatively assess the effects of chemical substances on ecosystems. The accuracy of ecological assessment methodologies that use data on the toxicity to organisms is increased by analyzing the relevant toxicity data for each organism. These methods are then combined with chemical dynamics models to develop ecological risk assessment models. This year, data on the environmental hazard of chemicals on ecosystems were gathered from several existing databases and references. We compiled and analyzed the data to clarify the intra- and interspecies variation in sensitivity to chemicals and to clarify the relationship between acute and chronic values. We also examined a method for testing sediment toxicity with the non-biting midge *Chironomus yoshimatsui*, a species endemic to Japan, to develop 2 new test guidelines proposed by OECD as drafts of 218 and 219.

Priority Research Areas

Understanding the Mechanisms of the Carbon Cycle

Climate change is caused by the increase of greenhouse gases (GHG), such as CO_2, CH_4, N_2O, and CFCs, in the atmosphere. The most important GHG, CO_2, is emitted by the combustion of fossil fuels and by deforestation, which are the 2 main driving forces behind climate change. However, the increase of GHG is not unidirectional—for example, more than 60% of anthropogenic CO_2 is absorbed by the terrestrial ecosystem and ocean. The main targets of this project are better qualitative evaluation of carbon sinks and sources, better understanding of the mechanisms of the carbon cycle, and better understanding of the temporal variability of CO_2. We focus our research activities on the following 4 points: (1) long-term monitoring of greenhouse gases with global interests on the ground, on the ocean, and in the atmosphere over the Asian continent, (2) assignment of terrestrial/ocean CO_2 sinks by observing the stable isotopes and the O_2/N_2 ratio in the atmosphere, (3) estimating the distribution of sub-continental terrestrial CO_2 sinks in the Asia-Pacific area by using data from the atmospheric observation network and by direct measurement of the CO_2 imbalance between atmosphere and ocean, and (4) estimating carbon sinks in forests by direct observation of CO_2 flux and by remote sensing.

Global environmental change and the impact of climate change—observation, analysis, and modeling

The purpose of the studies in this area is to develop a set of models for integrated assessment of economic growth, climate change, and the impacts of climate change. These models will then be applied to estimate the effects of the Kyoto Protocol and post-Kyoto interventions on global climate change and the regional impacts of this global climate change. This sub-project is also expected to clarify the most effective future strategies to integrate sustainable development in Asia with climate change mitigation with respect to alternative paths of future development.

In FY 2001, we developed GHG emission models, a new economic model to integrate the economy with energy and material flows, and a preliminary version of a new multi-regional, multi-sector general equilibrium model. We applied these models to analyses of climate change mitigation scenarios for various countries, analyses of emissions trading, cost analyses of the Kyoto Protocol, and global climate change mitigation scenarios for the IPCC. As for climate modeling, we started to improve the resolution and precision of our GCM. We also started to develop a regional climate model for the Asia-Pacific region as an interface between our global GCM and climate impact models. We developed the following impact assessment models: a revised water resource impact model, an economic model to assess optimal investment by China in water management infrastructure, and a preliminary version of a dynamic vegetation model.

Policy Studies on Japanese and Asian responses to Kyoto and post-Kyoto

The aim of these studies is to respond to new policy needs arising from the Kyoto Protocol, post-Kyoto negotiations, and long-term integration between climate policies and sustainable development policies. In order to promote this aim, we use political, legal, and economic analyses to assess previous processes of international negotiation,

international agreement, and international economic instruments. Model simulations are also used for future projections.

In FY 2001, we investigated the international negotiation process on issues regarding developing countries to find possibilities of a North-South consensus. We also conducted a number of simulation analyses to clarify feasible emission reductions of each country, as well as the effects of the Kyoto mechanism.

Elucidation of changes in the ozone layer and their effects, and monitoring and evaluation of the effectiveness of countermeasures taken

This field of research on the stratospheric ozone layer includes the research topics described elsewhere under the Special Priority Research Project "Monitoring of stratospheric ozone layer changes and understanding their mechanisms". In addition to those topics, we evaluated the effects of changes in the stratospheric ozone layer, tropospheric ozone, and air pollution on the amount of UV radiation reaching the earth's surface by analyzing the data on ozone and UV radiation in Sapporo, Tsukuba, Kagoshima, and Naha that have been observed and published by the Japan Meteorological Agency.

We also evaluated the effects of increased UV radiation on living organisms. We found that UV radiation might cause 8-hydroxyguanine, a newly identified gene-modifying substance, to accumulate in plant bodies. On the basis of results from domestic and foreign epidemiological studies on the effects of UV radiation on public health, it was shown that a significant relationship could be established between ocular exposure to UV radiation and the development of diseases, such as cortical cataract and pterygium.

We discussed a scheme for observing trace components in the atmosphere from space with an imaging Fourier-transform infrared spectrometer. We concluded that the total amounts of greenhouse gases in the atmosphere could be derived from observations using sunlight reflected from the sea surface as a light source.

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(1)System analysis for the shift to a low-environmental-load and material-cycle-oriented society

During the policy-making process for "Assessment Tools and Information for Supporting a Sustainable Material Cycling Society", we conducted research on the following issues: 1) material flow analysis in conjunction with an input—output table, 2) assessment of measures to promote resource recovery from the viewpoint of material lifecycles, 3) a method for diagnosing the regional applicability of recycling systems, and 4) the effective use and safety assessment of recycled products.

Outcomes related to research within this subtopic included:

- Corporate environmental measures are now in the 2nd phase. That is, the measures have been extended from manufacturers engaged in international trade to various other fields. However, there is still a gap between the image of so called eco-products held by companies and the image held by consumers.
- Because the ISO 14001 examination and registration is linked to many environmental load items, it is widely thought to be an effective measure to reduce environmental loads. However, we found that the association between the ISO 14001 standard and the reduction in environmental loads tends to be limited to a few specific environment loads.
- We created a multidimensional product input and output table (MDPIOT) by way of trial in our preliminary research; with this we established a framework to clarify "hidden material flows" and trade-derived international links.
- By using approximations of time-trend material flows, we estimated the quantity of material accumulated during the manufacture of an individual motor vehicle. By analyzing each major construction material, we were able to estimate by regional block the amount of stock and waste created by the construction of wooden and non-wooden buildings.
- Using an economic model we analyzed policies, such as tax policy, as well as technological advancements, the extent of environmental investments, development of environmental industries, and dematerialization.
- We held a workshop and, with the provided information and participant discussion, we comparatively assessed alternative waste management systems. Participants at the workshop also expressed their desire for comprehensive assessment of waste management systems and discussed a means of providing information.

(2) Development of technologies and systems for resource recycling and waste management

During the policy-making process for "Material Recycling, Waste Treatment, and Disposal Technologies", we discussed: 1) development of technologies to reduce environmental load in the process of recycling and disposal, 2) development of technology to increase the capacity of final disposal sites and the establishment of a method to select appropriate sites, 3) increasing stability in final disposal sites and development of risk reduction technologies, and 4) the analysis of a system to recover organic waste.

Outcomes related to research in this subtopic are as follows:

- Biological activated carbon treatment removed endocrine disrupting chemical substances not only by physical adsorption, but also by the action of the immobilized microbe's works.
- Dioxins could easily form during waste incineration under conditions where lignin and chlorine sources coexisted; the tendency of dioxins to form correlated with the binding energies of the chlorine atom and the metal atom in the solid phase of inorganic chloride.
- Only small amounts of dioxins formed if the furnace bed temperature was over 800˚C, even if a certain amount of chlorine was contained in the waste. On the other hand, if the temperature was below 800˚C, dioxins formed in proportion to the chlorine content of the waste.
- We created a chemical substance priority list for the field of waste disposal. We promoted optimized experimental assessment as a risk management tool for final disposal sites, based on the results of various chemical analyses and biological examinations.
- We discussed: computerizing disposal site ledgers and integrating them with GIS information, a method to assess the potential environmental pollution during the use of land after it is no longer used for waste disposal, the borderlines of investigation points, and a field examination method.

(3) Risk control related to material cycles and waste management

As part of the research conducted for the "Integrated Risk Control of Material Cycles and Waste Management" policy-making procedure we discussed: 1) bioassay-based comprehensive monitoring of recycled resources and waste, 2) formation and control of organic bromine compounds, 3) establishment of a comprehensive system for analyzing organic components in recovered resources and waste, and 4) development of technologies to decompose dioxins and PCBs in recovered resources and waste.

Outcomes related to research within this subtopic are as follows:

- We developed a method to estimate the amount of CFCs stored in air conditioners for business use. We clarified the decomposition characteristics of halons at high temperatures. We were able to estimate the decomposition percentage at any decomposition rate, any residence time, and any oxygen concentration.
- We investigated the actual situation of unintentionally formed persistent organic pollutants (POPs) and their occurrence in the environment, and formulated technical specifications for the collection, transportation, and storage of POP waste.
- We searched for interruptive substances for the immunoassay of dioxins in the soil.
- We selected factors for a zoning system used to monitor illegal waste dumping; we proposed a methodology for zoning "areas where waste is illegally dumped" and "areas into which illegally dumped waste spreads".
- We developed a system to detect waste dumping by using satellite-borne instruments including optical sensors, thermal infrared sensors, synthetic aperture radars, and panchromatic stereo sensors.

- We performed an experimental investigation to clarify leaching factors and a method to prevent leaching of heavy metals, including lead. We also used a tank leaching test to model the long-term leaching behavior of heavy metals.

(4) Technologies for remediation of contaminated environments

From research conducted during the policy-making process for "Technology and Systems for Development of Liquid Waste with Low-Environmental-Load and Resource Recovery", we have been developing: 1) a technological system that enables the removal and recovery of nitrogen and phosphorus, 2) a method to simplify and facilitate purification system management technologies, 3) a low energy, low cost, and low maintenance purification system tailored to the situation of individual developing countries, and 4) an environment improvement system using combined bio- and eco-treatments and physicochemical technologies.

Other outcomes of our research within this subtopic are as follows:

- We screened new microbes for their ability to remove mercury in the environment and isolated a mercury-volatilizing bacterium, *Bacillus* sp. strain D5, with high ability to remove mercury from contaminated water.
- We isolated an ethane-oxidizing bacterium, *Mycobacterium* sp. strain TA27 from soil; this strain can simultaneously degrade 1,1,1-trichloroethane and trichloroethylene (TCE). And we developed a rapid and specific enumeration method for a TCE-degrading methanotroph, *Methylocystis* sp. strain M, based on a polymerase chain reaction (PCR). We investigated the efficacy measurement of strain M by using a large-scale soil lysimeter.
- We extracted pollutants from environmental samples using new extraction media such as thermoresponsive polymers. By comparing the results with the results from organic solvents now used, we recognized that the use of these new extraction media is worth considering.

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Risk assessment and management of endocrine disrupting chemicals

Twenty-four research programs have focused on risk assessment and management of endocrine disrupting chemicals. Research included developing new chemical analysis methods, developing new bioassay and bio-monitoring methods, isolating and determining endocrine-active compounds, and exploring the effects of and the action mechanisms of synthetic and naturally occurring endocrine-active compounds. The targets of this research were mainly reproductive and immune systems and nerve and brain function in both wildlife and humans. The risk to human health and the assessment of environmental effects were also examined for pesticides, chlorination byproducts, and materials leaching from waste landfill sites. Information systems, including an integrated information system based on a GIS and a decision-making support system, were also developed.

Risk assessment and management of dioxins and related materials

Twelve research programs have been focusing on polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and co-planar polychlorobiphenyls (co-PCBs), as well as brominated dioxins and dibenzofurans. These research programs have developed new measurement methods, assessed human exposure and estimated body burden, and conducted simulations of global distribution and environmental fates of these compounds. Health effects were studied in relation to thyroid dysfunction, effects on male reproductive organs, and fetal development. The relationship between these compounds and increased epidemics of endomitolysis, the effects of oxidative stress, and the effects when combined with those of polyaromatic hydrocarbons were also studied.

Development of methods to monitor chemicals in the environment and analysis of their environmental fates

Seventeen research programs have focused on trace elements, radionucleotides, volatile organic materials of synthetic and natural origin, persistent organic pollutants (POPs), new bio-active compounds from algae, and organo-tin compounds. Within these research programs, new analytical methods were developed employing mass spectrometry using a new ionization mechanism, a new X-ray detection system, accelerator mass spectrometry, speciation and trace-characterization of heavy metals, and analytical quality control for atmospheric pollutants. These methods were used to analyze global cycling of elements, the distribution of POPs in the marine environment, and naturally occurring volatile organic materials from tropical areas. Toxicological studies of surfactants in water, organo-tin compounds in the marine environment, mercury in gold-rush areas, and other types of water pollution were also carried out with transgenic zebrafish.

Research on assessment and management of environmental risk

The research projects in this area comprise 7 sub themes: (1) development of an exposure assessment methodology that allows for variability, (2) development of a methodology to assess exposure based on limited information, (3) development of a methodology to assess health risks that considers susceptibility to chemical substances, (4) development of bioassay systems for environmental monitoring, (5) development

of a methodology to assess health risks from concurrent exposure to various chemical substances, (6) development of a methodology to assess ecological risk based on toxicities to individual organisms, and (7) development of a methodology for communication of risks. The results of some of these research projects are reported in Special Priority Research Projects and Policy-Response Research Centers (2) 2).
In this research area, studies on monitoring of long-term exposure to suspended particulate matter using bioassay evaluation were also implemented. We investigated the variation in dioxin concentration over time by analyzing suspended particulate matter stored at ultra low temperature. We also attempted to standardize and implement quality control of the bioassay of suspended particulate matter.

Clarification of mechanisms underlying adverse health effects due to harmful environmental agents, and the development of health effect detection methods
The health effects of polychlorinated aromatic compounds (dioxins, PCBs), environmental endocrine disrupters, heavy metals (cadmium, arsenic), and air pollutants (particulate materials, formaldehyde) were investigated, focusing on molecular mechanisms and methods for the detection of adverse effects. Genes that were up-regulated by dioxins, cadmium, and diesel soot extract were respectively identified in rat placenta, lung epithelial cells, and alveolar macrophages. The expressions of those genes may be good indicators by which to evaluate the health effects of environmental pollutants. The health effects of formaldehyde, one of the most important indoor air pollutants, were studied along the endocrine-neuro-immunotoxicity axis. An alveolar equivalent model was developed to assess the toxicity of air pollutants *in vitro*. This model is a functional integration of epithelial cells, fibroblasts, and mesenchyme, and has proved to be a useful tool to investigate patho-physiological changes in the pulmonary system. A new method for the detection of mutational changes has been developed using transgenic mice and fish; this method can be used to quantitate the toxicity of pollutant mixtures and environmental matrix specimens such as ambient air and water.

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Based on ecological and geographical information, and by using GIS technology, we have developed a method to assess habitat suitability for a number of wildlife species. In addition, we are assessing the role of landscape complexity in maintaining diversity in aquatic ecosystems, developing individual-based models that simulate the dynamics within plant populations to analyze the mechanisms of species coexistence and extinction in plant communities, investigating the ecological impacts of invasive species, and studying several genetically modified organisms to determine whether they are capable of dispersal into the natural environment.

We are developing environmental assessment techniques based on the ecological functions of freshwater wetlands, tidal wetlands, and rivers. Using these techniques, we assessed the decomposition rates on 13 Japanese tidal flats (wetlands), located between east Hokkaido and Iriomote Island, and compared the results with decomposition rates in freshwater wetlands. We found that decomposition rates were generally higher on the tidal flats than in the freshwater wetlands. We are also developing a method of using hydrolytic enzyme activities in sediments as an indicator of the rate of decomposition of organic matter in tidal flat ecosystems.

We are conducting a landscape-scale study of the ecological services provided by tropical forests in Peninsular Malaysia. These include functions in carbon sequestration and protection of biodiversity and socioeconomic values of tropical rainforests. The study also considers the regeneration process and reproductive phenology of major tree components at logging sites.

The sensitivity of plants to various detrimental factors in the environment is dependent on both genetic and environmental components. To clarify the genetic components, we isolated a large number of *Arabidopsis thaliana* mutants that exhibited varied sensitivities to the air pollutant ozone. Nine of these mutant lines showed clear and reproducible sensitivity to ozone, but differed in their sensitivity to various other stress factors. These results suggest that many genes are involved in determining plant stress sensitivity, and that these 9 mutants will be useful for identifying and isolating these stress-related genes.

We are conducting research on diversity of microorganisms and benthic animals from various aspects. To demonstrate environmental effects on symbioses, diversity of microalgal symbionts (lichen photobionts) was analyzed by DGGE method. Coccolithophorids are an important algal group that participates in global carbon and sulfur cycles. Life cycle analysis of the genus *Calyptrosphaera* indicated diversified coccoliths morphology in different life stages. We are also developing a taxonomic index of chiromonids according to morphology of larval head capsules that remain in gut contents of predators and sediment.

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Urban Air Pollution by Airborne Particulate Matter and Other Substances

The problem of urban air pollution by airborne particulate matter and other substances remains a serious environmental issue. To clarify the characteristics of urban air pollution, various studies are being conducted including: 1) important special research on $PM_{2.5}$ and DEP, mainly focusing on an emission inventory and reduction strategies, environmental behavior, measurement methodologies, and assessments of exposure and toxicity/; 2) special research on measures to prevent air pollution in China; and 3) risk assessment of environmental chemicals with regard to allergic reactions and diseases. Basic research, such as numerical simulations, measurement and monitoring methods, thermal environmental analysis of urban areas, and health impacts of air pollution, is also being conducted.

Long-range transboundary transport of air pollutants, such as acid rain precursors, and their environmental effects

The spatial distribution of atmospheric aerosols including Asian yellow sand (Kosa) was studied in relation to acid rain and photochemical pollution with the Chinese Research Academy of Environmental Sciences and the Sino-Japan Friendship Center for Environmental Protection. Various observations were also made in Japan, such as the continuous monitoring of air pollutants, lidar observations throughout the country, and ozone and oxidant observations in Oku-Nikko. In addition, we analyzed and modeled air trajectories, air mass characteristics, and transport processes of air pollutants originating from continental Asia. We collected and arranged the basic materials and information to create a source inventory. The nitrogen cycles and the influences of N-deposition to the deciduous forests and needle tree forests were studied in oligotrophic mountain areas to reveal the impacts of eutrophic acid rain containing high amounts of nitrogen compounds.

Integrated Management of the Environment

Changes in water circulation and the depletion and pollution of water resources in East Asia are among the top environmental problems of the 21st century. These problems are particularly striking in China, where the deterioration of natural resources—such as the blocking of the Yellow River, flooding of the Changjiang River basin, and desertification—is having a major impact on economic activity. We have conducted the following research to create sustainable environmental management proposals that encompass the application of environmental rehabilitation techniques, reevaluation of development plans, and strategies for reducing environmental load.

(1) From satellite data and ground observations, we have developed methods for measuring parameters—such as vegetation distribution, land surface temperature, snow accumulation, rainfall distribution, and soil moisture—that are important to understanding the circulation of water and other substances in river basins.
(2) We have established a model of terrestrial environmental management to forecast how human alterations to water circulation might affect ecological functions, such as agricultural output capacity and the preservation of water resources.
(3) We have sought to clarify the functions of marine ecosystems, principally that of

planktonic organisms, on the fate of pollutants from land into the seas.
(4) We have used a model of river basin environmental management that integrates land and marine environmental models to evaluate the impact on river basin ecosystems of power generation and water resource development—including dam construction and water transport between the Yellow River and Changjiang River basins, afforestation, water-conserving agriculture, and options for environmental preservation, such as industrial and residential wastewater processing. We will use this integrated model as a basis for proposing environmental management policies that support sustainable river basin development.

Lake and marine environments

Shallow coastal areas have been reclaimed without appropriate consideration of marine ecosystems. The Coastal Environment Research Team aims to develop a precise scientific method to evaluate the vulnerability of shallow-area ecosystems through a special research project.

As a part of the project, field surveys and *in situ* experiments were conducted at Matsukawa-ura to evaluate the biological efficiencies of shallow-water areas in preserving coastal ecosystems. Matsukawa-ura is a shallow, sandy lagoon, ca. 5 km long (north—south) and ca. 1 km wide (east—west), located in northeastern Fukushima Prefecture, Japan. Bivalves are the dominant macrobenthos in the shallow sandy area. The suspension-feeding bivalves increase the sedimentation rate of particulate matter and significantly reduce the plankton biomass; thus, they can clear the water column in shallow areas. High densities of bivalves not only remove materials from the water column, but also release a large amount of inorganic nutrients back into the water column by excretion, thus stimulating the primary production of seaweed and phytoplankton.

In Matsukawa-ura, the bivalves *Ruditapes philippinarum* and *Crassostrea gigas* are the dominant animals—their total biomasses (wet weight) were estimated to be 3.42×10^3 t and 2.34×10^3 t, respectively. Contributions of seaweed species to the nitrogen cycle were quantitatively examined *in situ* experiments and by field surveys. *Ulva pertusa* and *Zostera marina* were the dominant species during the summer season—their standing crops were estimated to be 0.29×10^3 t and 0.20×10^3 t, respectively. We performed *in situ* experiments to determine the DIN (dissolved inorganic nitrogen) uptake rate for *U. pertusa* and *Z. marina* during the summer.

We calculated an ecological model on the basis of the observed dataset, which included the nutrient load from streams and the nutrient exchange through the channel between Matsukawa-ura and the Pacific Ocean. The model showed that, compared with removal by tidal exchange, a significant amount of particulate organic matter was removed by bivalve filtration and a considerable amount of DIN was removed by seaweed. Thus, this natural water-purification system may act as the controlling factor of the material cycles in Matsukawa-ura.

Mechanisms of groundwater pollution

The pollution of groundwater threatens human health in many parts of the world. To protect human health from such pollution, we studied the mechanisms of groundwater pollution by nitrates and arsenic.

We studied new methods of monitoring and modeling nitrate pollution. We developed a rapid method for measuring the $\delta^{15}N$ of nitrate ions in water samples by using an isotope ratio mass spectrometer coupled to an elemental analyzer system. The $\delta^{15}N$ of nitrates in contaminated groundwater samples collected from a spring in a tea plantation area were close to the $\delta^{15}N$ in the organic fertilizers used in the plantation. To estimate the concentration of nitrates in the groundwater in the area of the tea plantation, we developed a water quality model based on flow rate and the quantity of accumulated nitrates in the groundwater. The concentrations of major ions, such as SO_4^{2-}, Cl^-, Na and Ca, were explained by the natural logarithm of the flow rate, whereas the concentrations of K, Mg, Mn, and Ni were explained to good precision by the nitrate concentration in a linear regression model.

Regarding pollution by arsenic, we studied environmental cycling of arsenic in groundwater, especially after its usage, in an arsenic-polluted area of West Bengal, India. Although volatile forms of arsenic are easily formed by reduction and methylation by biological activity, the environmental situation in the West Bengal area is not clear due to lack of appropriate field sampling methods for gaseous arsenic compounds. This year, while investigating chemical and physical sampling methods, we found a novel chemical reaction. Among various chemicals investigated, 1,3-dithiols with nitrogen in the 2-position were found to react with trialkylarsine and alkylarsine oxide, respectively forming stable pentavalent and trivalent heterocyclic arsenic compounds. The reactivity and stability of the compounds apparently depends on the size of the alkyl groups in the reagent. These novel reactions synthesize new arsenicals, and the results have been published. In addition to these chemical methods, we investigated physical sampling methods based on adsorbents.

Processes and mechanisms of soil pollution and deterioration, and their prediction

(1) Fundamental study on the fate of pollutants in water and soil environments

To assess the impact of biostimulation on actual gasoline-contaminated soil, we investigated changes in the indigenous bacterial community structure. We monitored these changes in bacterial community structure by using denaturing gradient gel electrophoresis (DGGE) and clone library methods based on 16S rRNA gene (rDNA) sequences. The results of DGGE, coupled with the use of principal component analysis and clone library analyses, were almost consistent. In the treated (fertilized) microcosm, the concentration of gasoline decreased and biodiversity of indigenous bacteria increased during the biostimulation period. The bacterial community structure in the control (non-fertilized) microcosm did not change. Our results suggested that the bacterial community structure was changed by the biostimulation treatment, and that the biodiversity of indigenous bacteria recovered.

(2) Surface alteration of silicate minerals during chemical weathering in nature

To elucidate the mechanism of silicate mineral weathering, we studied the surface

changes in acid-treated and naturally weathered biotites (a common rock-forming aluminosilicate mineral of the mica group) by means of secondary ion mass spectrometry (SIMS) and X-ray photoelectron spectroscopy (XPS). The surface characterization of acid-treated biotite showed that Fe, Mg, Al, and K were selectively leached during acid dissolution (0.05 M H_2SO_4), resulting in the formation of an altered layer residually enriched in Si ($SiO_2 \cdot nH_2O$) on the biotite surface. The depth of the Al depletion was less than that of the divalent cations, which indicates that Fe^{2+} and Mg^{2+} ions were more susceptible to leaching by the acid solution than Al^{3+} ion in the aluminosilicate framework. In contrast to the acid-treated biotite, a thick altered surface layer depleted in Fe, Mg, Al, and K was not found on naturally weathered biotite. Although the surface analysis of naturally weathered biotite showed the formation of an altered surface layer rich in Si, the altered surface layer was thinner and less pronounced than that of the acid-treated biotite. In addition, a slight enrichment of Al was observed on the surface of naturally weathered biotite. The surface enrichment of Al and Si during natural weathering may result from the depression of Al leaching (retention of the aluminosilicate structure) and/or the precipitation of hydroxides containing Al and Si caused by the moderate pH value of the ambient solution.

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Studies on measures to environmental pollution in developing countries

Developing countries are now facing various kinds of environmental problems that we have already experienced in Japan. Applying our knowledge and technologies, we have carried out the following 3 studies in China to characterize environmental problems in developing countries and to find clues to their possible solution. First, we used personal exposure monitors to study the levels of SO_2 and particulate matter exposure and their influence on the respiratory functions of schoolchildren and other residents of Shenyang. Second, we collected samples of urine, hair, coal, and tube-well water in areas of Guizhou Province where arsenic poisoning is prevalent and studied the effects of arsenic compounds on health. Third, to reduce SO_2 emissions from household coal combustion, we investigated how to develop technologies, such as dry coal-cleaning techniques, suitable for developing countries.

Relationships between Economic Development and Environmental Conservation in Developing Regions

The studies in this research area aim to provide integrated models of the environment and economy, as well as a strategic database with which to assess current and future interactions between economic development and environmental changes, and to predict the effects of strategic policy options for the developing regions of Asia. The studies also try to identify uniquely Asian factors to formulate an environmentally friendly lifestyle that leads toward sustainable consumption.

In FY 2001, we developed a simplified integrated economic—environmental model and used it to project future socioeconomic and environmental trends in 42 Asian countries. We also began to develop a computable general equilibrium model for analyses of sustainable development in Asia. As part of our lifestyle studies, we investigated how the Chinese lifestyle related to the environment and we compared it with lifestyles in developed countries; we identified some unique characteristics in recent Chinese trends.

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Monitoring of the Global Environment

Monitoring for global environmental issues is mainly directed by the Center for Global Environmental Research (CGER). Especially greenhouse gases (GHGs) are continuously observed at the two monitoring stations (Hateruma and Cape Ochi-ishi) in Japan. Latitudinal distributions of GHGs are also measured periodically over the Pacific by using commercial cargo ships. Furthermore, vertical profiles of GHGs are observed at three sites over Siberia.

All observations of these sites showed rapid increase rate in carbon dioxide concentration in the atmosphere in early 1998. Usually recent average increase rate was 1.6ppm/y, however, the rate at that time was over 3ppm/y, about twice of the usual rate. In Cape Ochi-ishi, which is located in northern Japan, about 4 ppm/y was even recorded. Such rapid increase of CO_2 concentration was well correlated with temperature anomaly in the Northern Hemisphere. Because of El Niño event in 1997-1998, higher temperature than usual year was recorded on a global scale. Higher temperature may accelerate respiration rate of plants and biota in soil, increasing flux of CO_2 from the land.

Anthropogenic input is a main cause of CO_2 increase in the atmosphere, however, variation originating from natural climatic changes may strongly affect the projection of CO_2 growth in the future.

Satellite Observation Project

We have continued to develop and test the data processing system for the satellite-borne ozone layer monitoring sensor ILAS-II (Improved Limb Atmospheric Spectrometer-II) developed by the Ministry of the Environment (MOE) and scheduled for launching in late 2002, we have prepared for practical system operations, and we have refined the data processing algorithms and operational system. We have also helped MOE by preparing ILAS-II validation experiments and setting up an ILAS-II data user group. In addition, we have completed the basic design of the data processing system for a next-generation sensor, SOFIS (Solar Occultation FTS for Inclined-orbit Satellite), now being developed by MOE for launch around 2007, and have contributed to the design and development of the equipment.

As part of our research into refining the ILAS-II data-processing algorithms, we reviewed the algorithms that were used to process data from ILAS—the predecessor of ILAS-II that made observations from November 1996 to June 1997. We reprocessed the data from the ILAS observations and made the refined products, such as ozone profiles, publicly available. Scientific analyses were made using ILAS data to demonstrate its effectiveness. Furthermore, to examine the atmospheric temperature and pressure profiles derived from ILAS data, we reevaluated the instrumental parameters of the ILAS visible channel spectrometer, and compared the derived ILAS data with the reference meteorological data.

Note that the Satellite Observation Project is part of the Special Priority Project "Monitoring of stratospheric ozone layer changes and understanding their mechanisms."

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Other Research Areas

Potential and Leading-Edge Research

In addition to the 7 Priority Research Areas mentioned in Section 6, NIES has been implementing research categorized as Potential and Leading-Edge Research. These research items will contribute to maintaining and strengthening the research capabilities of NIES in the long term, and will also contribute to the environmental research on which they are based.

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Intellectual Fundamentals for Environmental Studies

(1)Scientific Fundamentals

The Center for Global Environmental Research (CGER) operates various observation platforms to carry out continuous, long-term global environmental monitoring. These platforms are widely used for process studies, too. Most of these long-term process studies are moved to the monitoring phase, resulting in advanced new monitoring systems.

Monitoring Stations on Hateruma Island and Cape Ochi-ishi

These stations were set up mainly to monitor long-term baseline changes in global-warming gases at sites where the effects of urban air pollution are virtually negligible. Hateruma Station is located in Okinawa Prefecture on the eastern edge of Hateruma Island, Japan's southernmost inhabited island. Cape Ochi-ishi Station is located in Hokkaido Prefecture, at the tip of Cape Ochi-ishi, which is located at the end of the Nemuro Peninsula. These stations are automated systems for high-precision monitoring of global-warming gases and other atmospheric species; human attendance is not required.

Forest Sites for Carbon Cycle Research

The main research objectives of the Tomakomai Flux Research Site in northern Japan are to develop and evaluate observation systems for the measurement of fluxes of CO_2 and energy fluxes in the woodland ecosystem at Tomakomai National Forest in Hokkaido. Comprehensive research has been carried out, continuously monitoring a larch forest to elucidate the carbon cycle.

In 2001, CGER also started a multidisciplinary project monitoring forest management in a catchment basin in the Teshio Experimental Forest of Hokkaido University (CC-Lag experimental site).

Rikubetsu Stratospheric Monitoring Station

In collaboration with Nagoya University, CGER has been monitoring the stratospheric ozone layer over Hokkaido by remote sensing techniques in the Rikubetsu Astronomical Observatory, which is administered by the town of Rikubetsu. We monitor the vertical distribution of stratospheric ozone by millimeter-wave radiometer, harmful ultraviolet rays by Brewer spectrometer, and the vertical temperature distribution of stratospheric ozone by laser radar. The aim is to reveal the degree of ozone depletion in the stratosphere and the mechanisms underlying the "Arctic ozone hole".

(2)Laboratory of Intellectual Fundamentals for Environmental Studies (LIFES)

This laboratory consists of 2 research sections, the Environmental Analytical Chemistry Section and the Biological Resources and Informatics Section.

In the Environmental Analytical Chemistry Section, we have focused on the toxins of freshwater cyanobacteria. We isolated 2 new protein phosphatase inhibitors, oscillamide B and C, from the cyanobacteria *Planktothrix (Oscillatoria) agardhii* and *P. rubescens*. The structures of the inhibitors were elucidated by analysis of HRFABMS, 1-dimensional and 2-dimensional NMR spectra, and chemical

degradation. These inhibitors were ureido-containing cyclic peptides, and inhibited serine/threonine protein phosphatases PP1 and PP2A. Oscillamide C had IC_{50} values of 0.90 and 1.33 μmole/L against PP1 and PP2A, respectively. The inhibitory activities were closely related to the Arg and *N*-Me-Hty residues in the peptides.

Freshwater cyanobacteria produce microcystins (hepatotoxic cyclic heptapeptides), which are classified into 4 groups according to the amino acid structure at unit 7. Normal microcystins contain *N*-methyldehydroalanine (Mdha) or dehydroalanine (Dha) at unit 7, and comprise the greater part of all microcystins. We developed a new method for selective determination of normal microcystins: Only the Mdha or Dha in normal microcystins reacts with glutathione (GSH); this GSH–normal-microcystin conjugate was then reacted with 2,4,6-trinitrobenzene sulfonate (TNBS) and the resulting yellow-colored conjugate used for determination by colorimetry. This conjugate was then methanolyzed and dimethyl TNB-glutamate (the methanolyzed product) was determined by liquid chromatograph (LC)/ultraviolet (UV) detection and LC/mass spectrometry (MS). The detection limits of the total normal microcystin as determined by colorimetry, LC/UV, and LC/MS were 1 μg, 10 ng, and 0.1 ng, respectively.

One of our major research themes in the Biological Resources and Informatics Section has been the ecophysiological characterization of plant species distributed in arid and semi-arid regions of China. We investigated seed germination in 3 semi-shrub species distributed in the sandy deserts of China. The seed germination of these species was favored by dim light, but was inhibited when seeds were illuminated with strong light or maintained in complete dark. When seeds were buried at different depths in sand and irrigated, seeds buried shallowly germinated more favorably than those buried deeply or positioned on the surface, indicating that seeds buried shallowly were stimulated to germinate by dim light permeating through the thin sand layer. We concluded that the light sensitivity of the seeds ensures that they germinate at the appropriate depth; the emerging seedlings can thus avoid the dry conditions at the sand surface and the possible failure to emerge from deeper below the ground surface.

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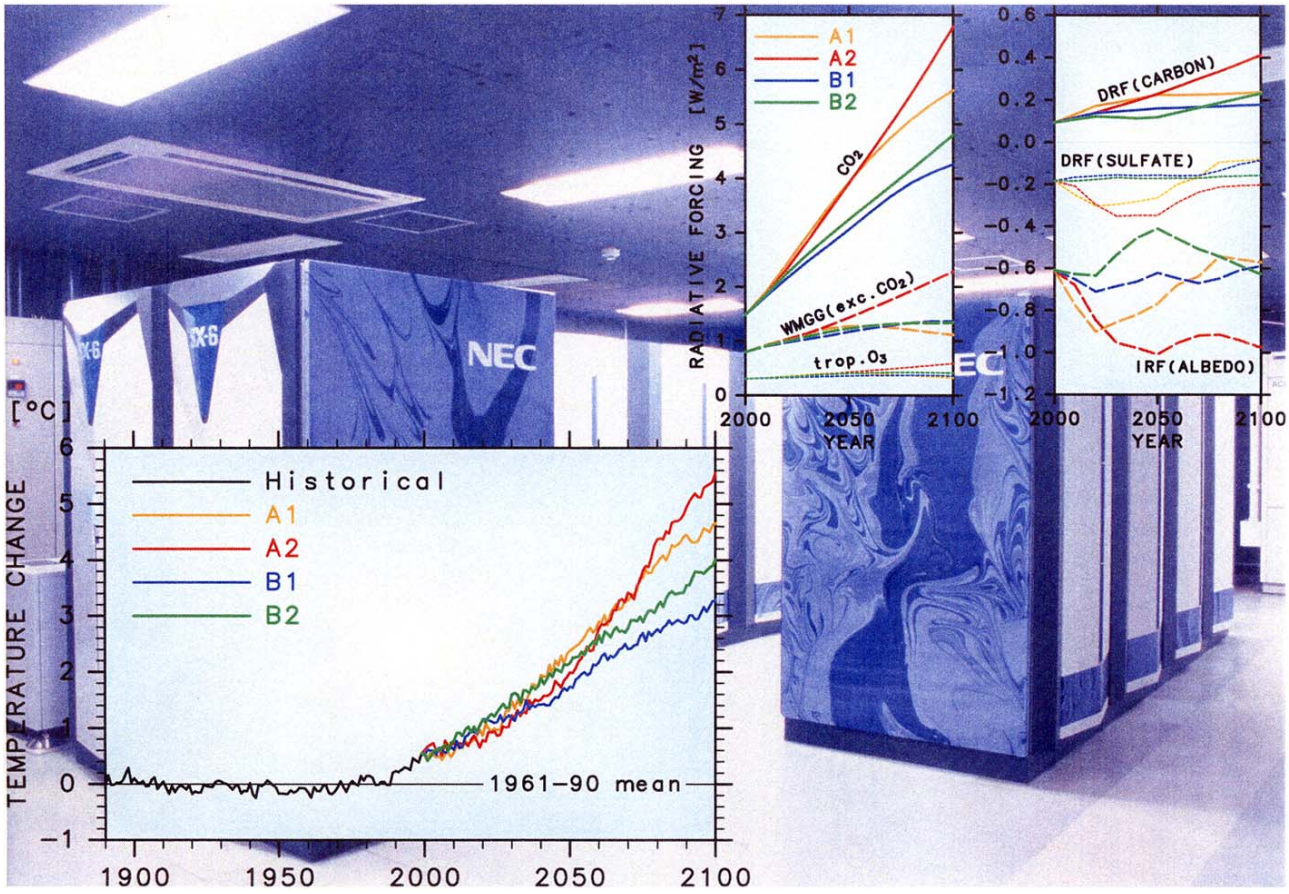
Center for Global Environmental Research



The future climate is simulated by use of supercomputer based on green-house gas emission scenario database.

As a result of the remarkable development of science and technology we are blessed with prosperity never before experienced. However, we consume much energy and many resources and are consequently facing a crisis because of serious damage to the global environment caused by rapid climate change due to the accompanying emissions of CO_2 and other greenhouse gases. International discussion on how to prevent the impending crisis is underway, but in practice, it is difficult to achieve both international and domestic consensus, partly because of the uncertainty of scientific assessments. CGER was established in 1990 to promote and support global environment research from both a national and international point of view to reduce the uncertainty of future prediction. CGER has 3 missions: synthesis of global environmental studies, support for global environmental research, and global environmental monitoring (see p.14).

Integration of Global Environmental Research

To effectively promote global environmental research in Japan, it is necessary to organize research activities into a unified national program through roundtable discussions and scientific communication. CGER is cooperating with the Global Warming Research Initiative of the Cabinet Office's Council for Science and Technology Policy to establish such a national project.
CGER publishes the current status of research activities in Japan in the monthly CGER News (available only in Japanese); there are currently 3500 subscribers to this publication and it also available from the NIES web site. CGER works as the secretariat office for the following projects: Asia Flux (a CO_2 flux observation network in Asia), GEMS/Water (a global water quality monitoring network), and UNEP/GRID-Tsukuba (a global research information database).

Monitoring of the Global Environment

Because changes in the global environment occur across such large areas and timescales, a key activity in this field of research is long-term monitoring. The global environment monitoring program directed by the Center for Global Environmental Research consists of 8 sub-programs: (1) continuous ground-based monitoring of greenhouse gases (GHG) and related trace gases at Hateruma Island and Cape Ochi-ishi, (2) aircraft-based monitoring of the vertical profile of GHG over Siberia, (3) monitoring of CO_2 flux over northern forests, (4) monitoring of atmosphere-ocean CO_2 exchange over the northern Pacific Ocean by cargo ships-of-opportunity, (5) monitoring of stratospheric ozone by measuring line profiles of millimeter-wave emissions, (6) an environmental UV monitoring network, (7) monitoring the ozone layer over the polar regions from space, and (8) the GEMS/Water Project.
The data obtained are available to researchers: some data are fully open, while some data are open only to cooperating researchers for a specified period of time.

Management of a Global Environmental Research Database

(1) Global Environmental Research Database

CGER continued to work on our original database of mitigation measures for climate change, and updated the IPCC scenario database of greenhouse gas emissions for predicting the future environment in the Asian region. We released on our web site the database containing measures to counter climate change in the Asia-Pacific region. We utilized remote sensing to measure the amount of greenhouse gases removed by sinks such as forests and forest soils. We also updated the inventory of sources of SO_2 and NO_x discharged in Korea, China, and India, which was created as a basic database for elucidating long-range trans-boundary air pollution in East Asia. We continued to work on our database of material flows. We also continued to collect terrestrial ecosystem data to ascertain the present conditions and changes in tropical forests based on our investigations in a tropical forest plot in Malaysia (Figs. 1 and 2).

Fig. 1
Study sites for the tropical terrestrial ecosystem database.
● : Joint project sites with Center for Tropical Research Institute of the Smithsonian Tropical Research Institute (CTFS/STRI)
● : Study sites operated independently by a local research institute or jointly operated with CTFS/STRI sites.

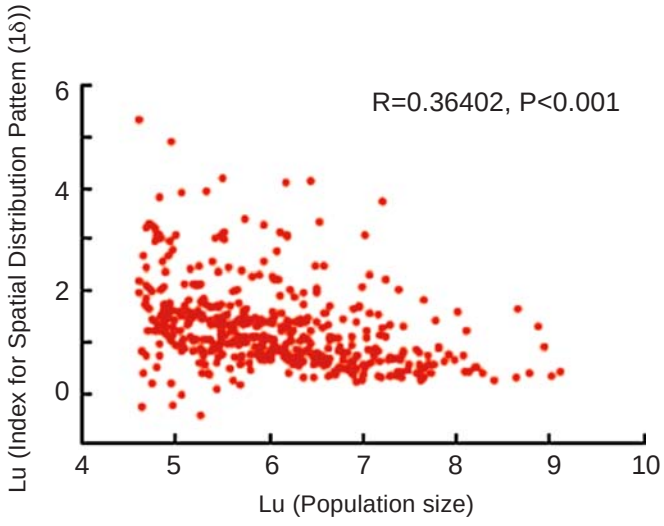


Fig. 2
The relationship between population size (stem density) and the spatial distribution pattern as expressed by Iδ in the Pasoh Forest Reserve.

(2) GRID-Tsukuba

The Global Resource Information Database (GRID) was established in 1985 within UNEP for the timely provision of useful environmental data to the world community of researchers and policy makers. GRID-Tsukuba was founded at CGER in May 1991 as the 8th GRID Center. The service started in April 1992. We developed databases based on a forest ecosystem model and a forest carbon stock model, and we also conducted global analyses with these models. We reported GRID-Tsukuba's activity at the Second Collaborative Assessment Network Meeting held in Bangkok, Thailand on 22 and 23 November 2001.

Coordinating Supercomputer-Aided Research Programs

In order to predict climate change on a 100-year timescale, several groups of scientists around the world have conducted model calculation based on several emission scenarios proposed by the socioeconomic research group. The prediction of the risk of the regional climate change is another important task of climate research. To promote such global environment researches, a new supercomputer system, NEC SX-6/64MB (64CPU, 512GFLOPS, 512GB memory) was introduced in 2002. CGER publishes its annual "SUPERCOMPUTER ACTIVITY REPORT".

Conference and Workshop

- "International Workshop on Carbon Sinks and the Present State of Research in Forest Sector" (Tokyo, Aug., joint hosting with FFPRI)
- "International Workshop on Climate Change and Wetland Conservation" (Kushiro, Sept., joint hosting with Kushiro City and Ministry of Environment)
- "6th International Carbon Dioxide Conference" (Sendai, Oct., assent) (Fig. 3)
- "The 2nd International Workshop on Advanced Flux Network and Flux Evaluation" (Jeju, Korea, Jan., joint hosting)

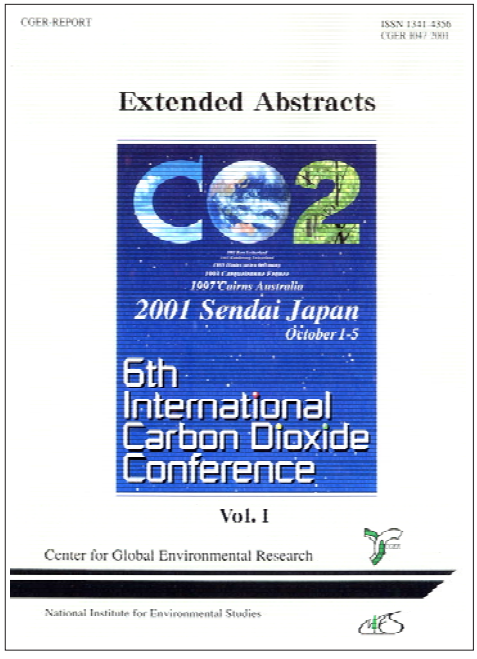
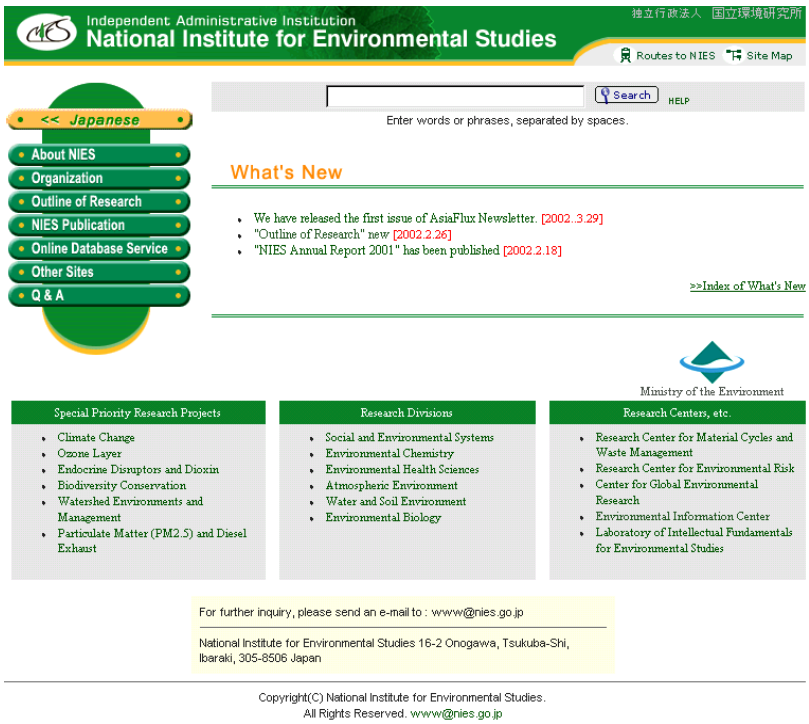


Fig. 3
Extended Abstract of 6th International Carbon Dioxide Conference was published in 2001. This conference is held every fourth year and the newest advanced research results are presented.

Environmental Information Center

NIES WWW (http://www.nies.go.jp)



The Environmental Information Center (i) provides information technology support for research and related activities in NIES, and (ii) carries out public relations activities for NIES and publishes NIES research reports, etc. In addition to these activities, the Center promotes the collection, processing and dissemination of environmental information.

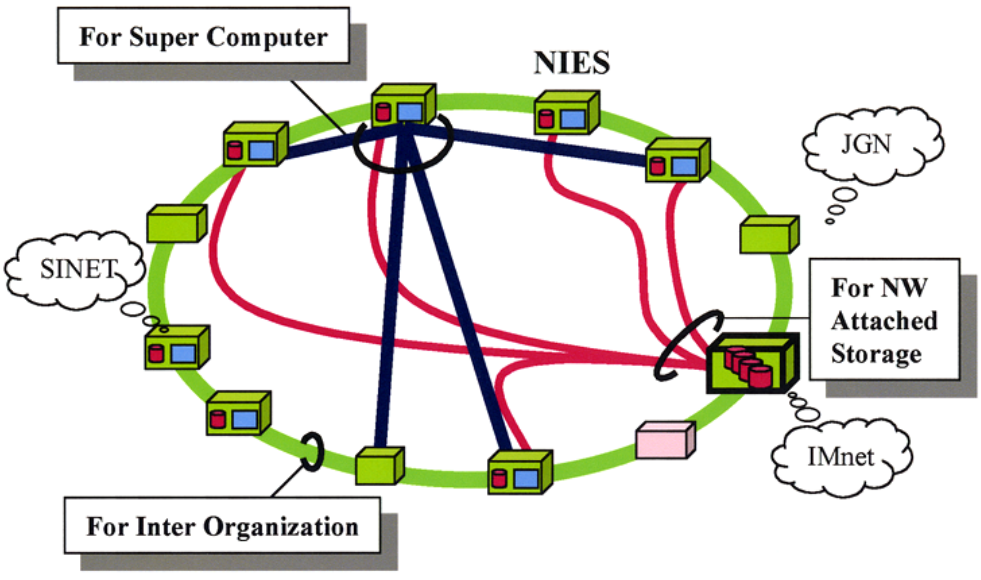
(i) Information technology support for research and related activities in NIES

The activities of the Center in this field comprise: (a) management and operation of computers and related systems; (b) compilation of documentary information on environmental research; and (c) library management and operations.

(a) Management and operation of computers and related systems

A new computer system started operation in March 2002. The system is an integration of a general-purpose computer system and a supercomputer system to meet the increasing demand for computing resources and a multiplicity of processing tasks. This UNIX-based computing environment consists of a supercomputer system and various subsystems, such as a scalar-computing server, a front-end server, storage devices, and application servers. Our vector-computing server (NEC SX-6/64M8), which employs an operating system equipped with a FORTRAN compiler with high-level debugging capability and high-efficiency optimization, executes large-scale programs necessary to handle global environmental problems.

A LAN called NIESNET was established at NIES in 1992. File transport in various computer systems, including the Gigabit Ethernet, was upgraded in March 2002. The network configuration was restructured, and large-scale file transport performance was improved at that time. Registered users outside the Institute have remote access to the supercomputer system through the Tsukuba-WAN via the Inter-Ministry Network (IMnet) connection to the Internet.



Configuration of Tsukuba-WAN

(b) Compilation of documentary information on environmental research

Documentary information on environmental research and related subjects are essential to competent research in NIES. To offer the information to NIES researchers, the Center has introduced off-line and on-line commercial databases such as JOIS, DIALOG, STN-International, G-Search, and the British Library inside web.

(c) Library management and operations

As of March 2002, the NIES library held 43662 books, 583 technical and scientific serials, 8501 maps, 114 963 microfiches, and various other reports and reference materials. Library facilities include separate reading rooms for books, journals, indexes and abstracts, reports, and maps and microfiche, as well as a database access room.

(ii) Activities promoting NIES public relations and the publication of NIES research reports, etc.

The activities of the Center in this field comprise (a) management of the NIES-WWW internet portal and (b) editing/publication of the NIES Annual Report, research reports, etc.

(a) Management of NIES-WWW

NIES began to provide public information on its research activities and results via the internet (www.nies.go.jp) in March 1996. Because NIES was restructured in April 2001 with a new status as an independent administrative institution, the homepage was completely renewed and improved.

(b) Editing/publication of the NIES Annual Report, research reports, etc.

Reports concerning NIES research activities and results, official newsletters (NIES News, in Japanese), NIES research booklets (Kankyo-gi, in Japanese) are edited, published and distributed by the Center. The Kankyo-gi, in which NIES research results are rewritten to promote easy understanding, was started in this fiscal year.

(iii) Other activities

In addition to the activities mentioned above, the Center (a) collects, processes, and disseminates environmental information, (b) acts as the national focal point of UNEP-Infoterra, and (c) conducts tasks commissioned by the Ministry of the Environment.

(a) Collection, processing, and dissemination of environmental information

The collection, processing, and dissemination of environmental information are carried out as stipulated in the Law for the Establishment of NIES. The Center (a-1) processes and manages environmental information databases, and (a-2) provides environmental information using GIS (geographic information system).

(a-1) Processing and management of environmental information databases

Various environmental data are needed for research, policy decisions, and policy enforcement. The Center compiles and processes air quality and water quality data as measured by local governments and reported to the Ministry of the Environment. These processed data can be accessed through the database on NIES-WWW, and duplication services and lending services are also available.

(a-2) Provision of environmental information using GIS

The Center, with the cooperation of the Ministry of the Environment, has been developing environmental data provision system using GIS. Such system can help users easily understand the status of the environment, because the system show data

on environmental quality together with other information on maps. This system will soon be publicly available through the internet.

(b) National focal point of UNEP-Infoterra

UNEP-Infoterra is the global environmental information exchange network of the United Nations Environment Programme. The network operates through a system of government-designated national focal points. The Center has been the designated national focal point for Japan since 1975. These focal points provide a wide range of environmental information including directories of information sources.

(c) Tasks commissioned by the Ministry of the Environment

The Center has started 4 tasks commissioned by the Ministry of the Environment this fiscal year.

(c-1) Development of an information system on total management of aquatic environments

The purposes of the system are to help a wide range of people understand the aquatic environment and to support conservation activities and scientific investigations. The Center has developed a number of data management programs and a GIS to show the programs on a map.

(c-2) Management of display systems for wide area air pollutant surveillance

In June 2001, the Center started test operations of a system developed for enforcement of air pollution controls against photochemical oxidants, etc. This fiscal year, while managing the developed system, a GIS with a number of maps showing various functions was added. In January 2002, the system was made publicly available through the internet.

(c-3) System development in compliance with PRTR law

Under the Law Concerning Pollutant Release and Transfer Register (PRTR law), the government is obliged to compile and release data reported by industry. The Center has started to develop a system to compile this data and to make it publicly available. This fiscal year, we created the basic design of the system while preparing to release the PRTR results compiled from the previous pilot study.

(c-4) Development of an information management system on noise, vibration and offensive odor

This fiscal year, we conducted a preliminary study into the configuration and conceptual design of a system to compile data on noise, vibration, and offensive odor, and release it via the internet.

Laboratory of Intellectual Fundamentals for Environmental Studies

A new building for Biological Resource Collection

This laboratory consists of 2 research sections, the Environmental Analytical Chemistry Section and the Biological Resources and Informatics Section. They are responsible for organizing all of intellectual research fundamentals accumulated since NIES began, and for developing basic research techniques that will be needed in the future. These techniques are used within NIES for effective implementation of research and to form research networks. They are also made available to organizations outside NIES.

Preparation of Environmental Certified Reference Materials (CRMs) and analytical standards for environmental analysis, and long-term storage of environmental samples (Environmental Specimen Bank)

This fiscal year, one of the CRMs we prepared was a standard material made of leaves of tea; we analyzed metal elements and other chemicals in this standard material for quality assurance. We also provided over 60 other CRMs this fiscal year.

For retrospective analysis of pollutants, we collected and prepared environmental samples for long-term, low-temperature storage. Samples included air-particulates, human milk, snails, and bivalves collected from highly polluted areas and from areas where pollution is at background levels. The collection and storage of such samples has continued for more than 20 years.

Reference laboratory function

This facility serves as a reference laboratory for environmental research in Japan through 1) improving methods to ensure analytical quality control and cross-checking analytical techniques and 2) improving methods of classifying and identifying microalgae and laboratory organisms, and preserving and supplying those organisms to provide standards for classification, standard strains for AGP tests, and strains with special functions.

Fig. 1
The home page of MCC-NIES. (the Microbial Culture Collection at the National Institute for Environmental Studies)

During this fiscal year, we analyzed the lake sediment and soil samples that were prepared as CRMs in 1997 to determine the quality assurance values for several analytical institutions.

The taxonomic positions of various genera of coccoid green algae are now being revised by molecular phylogeny. DNA extraction and PCR amplification of the 18S rRNA gene were carried out for 70 strains preserved in the Microbial Culture Collection. Among them, we determined the complete gene sequences for 34 strains and identified the appropriate taxonomic positions of those green algae (Fig.1).

Investigation, collection, and storage of microbes useful for environmental conservation; development of laboratory organisms; and preservation of cells and genes of endangered wildlife species

This year, the Committee for Evaluating Microbial Culture Strains gave its approval to add 67 new microalgal strains to the collection. At present, 877 strains of microbes are preserved, including 2 strains of protozoa. In addition, we have been developing cryopreservation techniques. We provided 575 strains to researchers and research institutions all over the world.

To aid in the preservation of endangered wildlife species, as well as endangered aquatic plants such as charophytes and freshwater red algae, we have been developing systems for preserving body cells, reproductive cells, and genes.

In addition, we investigated an endangered species of scud *(Jesogammarus spinopalpus)* and a freshwater goby *(Rhinogobius* sp.*)* as new experimental animals to assess the hazards of pollutants in aquatic ecosystems (Fig.2).

Fig. 2
Endangered macroalga, Thorea odadai.

Development of information networks for biological resources

The laboratory has been promoting governmental and international collaboration relating to information about and classification and preservation of biological resources, and promoting the creation of national and international networks for the exchange of biological resource information.

Management and operation of analytical equipment

The laboratory has been working to improve the sensitivity and accuracy of analysis using environmental specimens at NIES, and has been managing and operating common-use equipment, such as GC/MS, ICP/MS, electron microscopes, and NMR, that supports the development of new analytical methods (Fig.3).

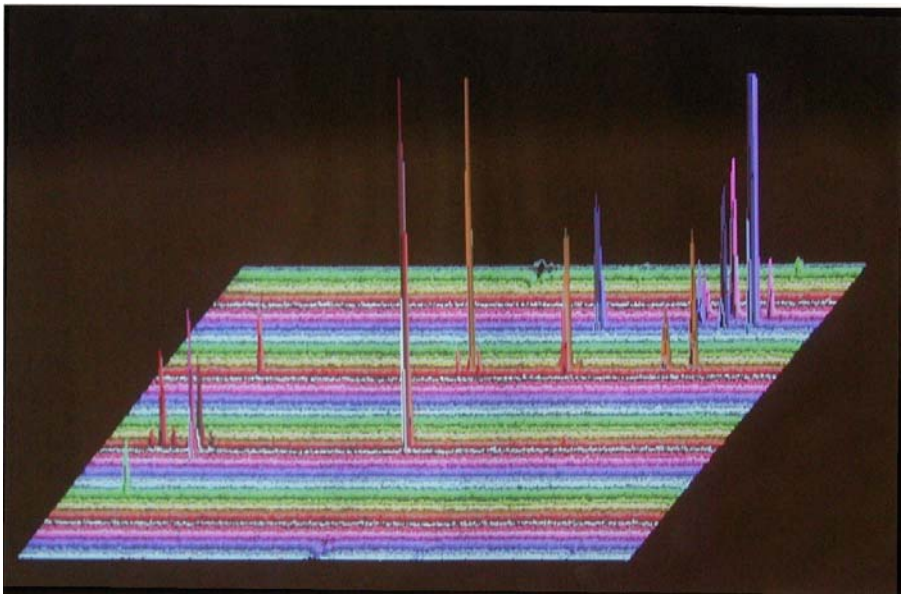


Fig. 3
A 2-dimensional NMR spectrum of an aromatic compound obtained from a Jeol JNM A-500 spectrometer. (^{1}H, 500MHz; ^{13}C, 125 MHz)

International Workshop on Carbon Sinks and the Present State of Research in Forest Sector

August 30, 2001
Ibuka Memorial Hall, Waseda Univ., Tokyo

The aim of this workshop is to introduce a present state of environmental research on carbon sink with reference to the Kyoto Protocol especially focused on the role of forests. 419 people from scientific communities, governments, private sectors and general public are participated in this workshop. Latest scientific reports were presented by scientists from U.S., Sweden, New Zealand and Japan following brief introduction of Kyoto Protocol by Japanese Ministry of the Environment.

International Workshop on Climate Change and Wetland Conservation

September 20-21, 2001
Kushiro Tourism and International Relations Center, Hokkaido, Japan

The aim of this workshop is to discuss linkages between Climate Change and Wetland Conservation among interested parties in the world. Over 150 people including scientists from U.S., Russia, Australia, Malaysia and Japan are participated. The proceedings of the workshop was published as CGER Report.

The 7th International Joint Seminar on the Regional Deposition Processes in the Atmosphere (7th International Workshop on the Comparison of Trans-boundary Air Pollution Model and Harmonization of the Methodology of Emission Inventories of Air Pollutants in East Asia)

November 20-22, 2001
NIES, Tsukuba, Japan

This Seminar focuses mainly on three fields of research: observation of air pollutants, modeling, and emission inventory. Each of these efforts in strengthening the international scientific community contributes to the tackling of air pollution and acid deposition. 37 researchers from 8 countries gathered in this workshop and many practicable and unique methods of addressing problems associated with acid deposition and air pollution are presented.

International Toxic Algae Control Symposium

Strategies on Toxic Algae Control in Lakes and Reservoirs for Establishment of International Network

February10-16, 2002
Tsukuba International Congress Center, Tsukuba, Japan

Asia-Pacific region including Japan are facing the problem of the toxic algae bloom and various problems about water quality safety in lakes, marshes and reservoirs etc. This workshop promoted to establish an international network where information and opinions of the Bio-eco engineering system, which may be suitable for the Asia-Pacific region due to application of energy-saving and low cost system, could be exchanged. Many researchers from institute of international agencies working on related issues participated in this workshop.

International Workshop for Arsenic Contamination in Groundwater-Technical and Policy Dimensions

February18-19, 2002
UN House Tokyo, Japan

The arsenic pollution crisis in Bangladesh and West Bengal, India is a disaster of unprecedented proportions. The aim of this workshop is defining a comprehensive strategy that deals with both policy and technical issues.
The following are the objectives of the workshop:

1. Further the dialogue on development of a comprehensive strategy to deal with the problems faced in Asia, including identification of approaches towards developing a comprehensive strategy for various stakeholders.
2. Identify means and ways to communicate the workshop's recommendations to a wider audience, with particular reference to the discussions to be held in the 3rd World Water Forum 2002.
3. Discuss linkages to arsenic problems in other parts of the world and ways to extrapolate findings from South Asia to other regions.

COUNTRY
No. Title
Collaborating Institution
NIES Partner (As of Latest Review Meeting)

AUSTRALIA
1. Cooperative research on global environmental monitoring
CSIRO
Atmospheric Environment Div.
2. A comprehensive database of microbial diversity:cyanobacteria
University of NSW
Environmental Biology Div.
3. Trace characterization of organic/inorganic carbon in marine environment
WA. Marine Res. Labs
Regional Environment Div.

CANADA
1. Arctic atmosphere under polar sunrise
Atmospheric Environment Service
Environmental Chemistry Div.
2. Elucidation of the cycling and transformation of chemical substances in the North Pacific Ocean
Dept. Chemistry, Univ. British Columbia
Environmental Chemistry Div.
3. Monitoring of the atmosphere-ocean carbon dioxide exchange rate
Center for Ocean Climate Chemistry, Institute of Ocean Sciences
Global Environment Div.
4. Development of new methodologies to assess physiological effects by environmental pollutants
University of Western Ontario
Environmental Health Sciences Div.

CHINA
1. Advanced wastewater treatment processes for China
Research Institute for Environmental Engineering/Dept. Environmental Engineering, Tsinghua Univ.
Regional Environment Div.
2. Advanced sewage treatment processes by soil system applicable to China
Institute of Applied Ecology, Chinese Academy of Sciences
Regional Environment Div.
3. Development of wastewater and water resources treatment processes applicable to China
Chinese Research Academy of Environmental Sciences
Regional Environment Div.
4. Preparation and evaluation of environmental certified reference materials
China-Japan Friendship Environmental Protection Center
Environmental Chemistry Div.
5. Development of monitoring method and surveillance of dry deposition
China-Japan Friendship Environmental Protection Center
Atmospheric Environment Div.
6. Effects of environmental load on marine ecosystem in the East China sea and the impacts of runoff on marine ecosystem
Department of International Cooperation State Oceanic Administration
Water and Soil Environment Div.
7. A study on the health effects of heavy metals in China
Environmental Medical Research Institute, Beijing Medical University
Environmental Health Sciences Div.
8. Research on the development of water pollution control techniques for the Taihu Lake in China by bio/ecoengineering
Chinese Research Academy of Environment Sciences
Water and Soil Environment Div.
9. Dioxins analysis and survey of dioxins sources in China
China-Japan friendship Center for Environmental Protection
Regional Environment Div.
10. Development of suitable technologies to control the greenhouse gas emission during the treatment of domestic waste water
Tongji University
Regional Environment Div.
11. Development of eco-engineering technologies for the control of eutrophication in the drainage area Honfeg Lake and Baihua Lake in China Guizhou
Guizhou Provincial Environmental Protection Bureau
Regional Environment Div.

FRANCE
1. Ozone layer observation from satellite
Lab. Physique Moleculaire et Applications, CNRS/Univ. Pierre et Marie Curie
Global Environment Div.
2. Assessment of lung injury by air pollutants
Unite de Biologie Moleculaire, Hospital Armand Trousseau
Regional Environment Div.
3. Chemotaxonomy and molecular phylogeny of cyanobacteria
Institute Pastuer
Environmental Biology Div.
4. A molecular biological study for mechanisms of environmental adaptation plants
University of Picardie
Environmental Biology Div.
5. Studies on intermediary species in atmosphere and flames
Lab. of University Pierre et Marie Curie
Environmental Chemistry Div.
6. Biodiversity of microalgae obtained from the Atlantic and the Pacific Ocean
University of Caen
Environmental Biology Div.
7. Hormonal regulation of the toxicity of environmental pollutants
INSELM U469
Regional Environment Div.

GERMANY
1. Comparative study on total material flow balance between Japan and Germany
   Wuppertal Institute for Climate, Environment and Energy
   Research Center for Material Cycles and Waste Management
2. Studies on eutrophication and related problems in closed water bodies
   Nuclear Research Center, Karlsruhe
   Office of International Coordination
   (for Water and Soil Environment Div.)
3. Satellite measurement of atmospheric gases (ADEOS project)
   Alfred Wegener Institute
   Ozone Layer Research Project
4. Testing method of endocrine disrupting chemicals
   University Stuttgart, Institute for Sanitary Engineering
   Environmental Chemistry Division / Endocrine Disrupters & Dioxin Research Project
5. Workshop on solid waste management
   Federal Environmental Agency
   Research Center for Material Cycles and Waste Management

KOREA
1. Aircraft and ground-based observations of acidic and/or oxidative pollution in East Asia
   Environment Research Center, Korean Institute of Science and Technology
   Atmospheric Environment Division
2. Cross-cultural comparison of landscape evaluation between Japanese and Korean
   KyungPook University
   Social and Environmental Systems Div.
3. Study on the monitoring of harmful algal bloom and effects of nitrogen and phosphorus
   National Institute of Environmental Research
   Research Center for Material Cycles and Waste Management
4. Study on the monitoring of long range transported air pollutants and acid deposition in the northeast Asia region
   Department of Air Pollution, National Institute of Environmental Research
   Atmospheric Environment Div.
5. Study on the marine pollution using ship-of-opportunity
   Korea Ocean Research and Development Institute
   Water and Soil Environment Div.
6. Study on the long range transport of POPs by using ship-of opportunity
   Korea Ocean Research and Development Institute
   Environmental Chemistry Div.
7. Research on the prevention and management of Environmental Disease
   National Institute of Environmental Research (NIER)
   Environmental Health Sciences Div.

NORWAY
1. Studies on analyses of observed data of the stratospheric ozone layer
   Norwegian Institute for Air Research
   Global Environment Div.
2. Global environmental database
   GRID-Arendal
   Center for Global Environmental Research

POLAND
1. Molecular mechanisms of plant adaptation to atmospheric stresses
   Plant Breeding and Acclimatization Institute
   Regional Environment Div.
2. Establishment of methodology of health risk assessment on air pollutants
   Institute of Occupational and Environmental Health
   Environmental Health Science Div.

RUSSIA
1. Research programs under the Baikal International Center for Ecological Research (BICER)
   Limnological Institute, Russian Academy of Sciences
   Environmental Chemistry Div.
2. Airborne measurement of greenhouse gases over Siberia
   Central Aerological Observatory
   Center for Global Environmental Research
3. Modeling of methane emission rates from natural wetlands
   Institute of Microbiology
   Center for Global Environmental Research
4. Measurement of methane emission rates from permafrost areas
   Permafrost Institute
   Center for Global Environmental Research
5. Environmental change and its effects on the global warming in Siberian permafrost region
   Yakut Institute of Biology, Permafrost Institute, Pacific Oceanological Institute
   Center for Global Environmental Research
6. Vertical profile measurement of greenhouse gases over Siberia
   Institute of Atmospheric Optics
   Center for Global Environmental Research
7. Study of measurements of atmospheric trace secies using FTIR and other methods in Siberia area
   Institute of Sollar-Terrestrial Physics (ISTP), Siberian Dep. Russian Academy of Science
   Atmospheric Environment Div.

SPAIN
1. Development of new methodologies to assess physiological effects by environmental pollutants
   Dept. Cellular Biology, Autonomous Univ. Barcelona
   Environmental Health Sciences Div.

SWEDEN
1. Development of risk assessment methodologies using *in vitro* toxicity testing
   Dept. Toxicology, Uppsala Univ.
   Environmental Health Sciences Div.

2. Health risk assessment of heavy metal exposure: Effects of increase in human activity
   Kalolinska Institute
   Environmental Health Sciences Div.

U. K.

1. *In vivo* NMR spectroscopy method and its application to the field of environmental health
   Dept. Biochemistry, Univ. Cambridge
   Endocrine Disrupters & Dioxin Research Project
2. Effects of environmental pollution on the metabolism of trace elements in man
   Rowett Research Institute
   Environmental Health Sciences Div.
3. Algae and Protozoa
   CCAP, Institute of Freshwater Ecology
   Environmental Biology Div.
4. Cooperation on the development and application of Coupled Chromatography-Accelerator Mass Spectrometry Techniques
   University of Oxford
   Environmental Chemistry Div.
5. Structural and biological characterization of novel toxic products in filamentous cyanobacteria (*Oscillatoria* and *Nostoc*) from Japanese and British waterbodies
   Department of Biological Sciences, University of Dundee
   Laboratory of Intellectual Fundamentals for Environmental Studies
6. Studies on molecular biology and ecology of methanotrophs
   University of Warwick, Department of Biological Sciences
   Water and Soil Environment Div.

U. S. A.

1. Ecological and physiological aspects of methanotrophs
   Dept. Microbiology, Biochemistry and Molecular Biology, Univ. Maine
   Water and Soil Environment Div.
2. Development of bioremediation technologies for cleanup of contaminated soil
   Center for Environmental Biotechnology, Univ. Tennessee
   Water and Soil Environment Div.
3. Precise measurement of the greenhouse gases in the global baseline atmosphere
   Climate Monitoring and Diagnostics Lab, NOAA
   Center for Global Environmental Research
4. Health impacts of climate change and environmental degradation on human morbidity in regional societies
   National Institute of Environmental Health Sciences
   Regional Environment Div.
5. Effects of logging on lakes ecosystems
   University of Alaska Fairbanks
   Regional Environment Div.
6. Human impacts on biodiversity and nutrient cycling in mire wetland
   Smithsonian Institute
   Environmental Biology Div.
7. Establishment of phytotron research network
   Duke University
   Environmental Biology Div.
8. Studies on standardization of measurement and health effect of particulates
   USEPA, National Center of Environmental Assessment
   Environmental Health Sciences Div.
9. Studies on the feasibility of the FTIR network for vertical profiling atmospheric trace species
   University of Denver
   Atmospheric Environment Div.
10. Conservation and reproductive biology of wildlife
    Department of Animal and Plant Science, Sheffield University
    Global Environment Div.

CANADA	Agreement between National Institute for Environmental Studies and Institute of Ocean Sciencies (1995).
CHINA	Agreement for Collaborative Research to develop a Chinese Greenhouse Gas Emission Model. Energy Research Institute of China (1994).
	Agreement on cooperative research projects between the National Institute for Environmental Studies, Environment Agency of Japan and the Institute of Hydrobiology, Chinese Academy of Sciences (1995).
	Memorandum of understanding between Institute of Hydrobiology, Chinese Academy of Sciences, Peoples's Republic of China (IHBCAS) and National Institute for Environmental Studies, Japan (NIES) for collaborative research on microalgal toxicology, systematics and culture collection operations (1995).
	Memorandum of Understanding between Institute of Remote Sensing Applications, Chinese Academy of Science, People's Republic of China (IRSACAS) and National Institute for Environmental Studies, Japan (NIES) for Collaborative Research on Development of Remote Sensing and GIS Systems for Modeling Erosion in the Changjian River Catchment (1996).
	Memorandum of Understanding between Changjiang Water Resources Commission, Ministry of Water Resources, People's Republic of China and National Institute for Environmental Studies, Japan for Collaborative Research on Developments of Monitoring Systems and Mathematical Management Model for Environments in River Catchment (1997).
	Memorandum of Understanding between National Institute for Environmental Studies, Japan (NIES) and Chinese Research Academy of Environmental Sciences, People's Republic of China (CRAES) for Collaborative Research on Advanced Treatment of Domestic Wastewater (1997).
	Memorandum of Understanding between National Institute for Environmental Studies and School of Environmental Sience and Enginering Shanghai Jiao Tong University for Collaborating Research on Eutrophicated lake and marsh water improvement using Bio-ecoengineering Technology (2000).
	Memorandum of Understanding Between Northwest Plateau Institute of Biology, the Chinese Academy of Sciences, P. R. China (NPIB) and National Institute for Environmental Studies, Japan (NIES) for Collaborative in Alpine Grassland Ecosystem (2001).
INDIA	Memorandum of Understanding between the Indian Council of Agricultural Research and the National Institute for Environmental Studies for Collaborative Research on Desertification (1993).
INDONESIA	Memorandum of Understanding between Research and Development Center for Biology, Indonesian Institute of Sciences (RDCP-LIPI), Bogor-Indonesia and National Institute for Environmental Studies, Tsukuba-Japan concerning Scientific and Technical Cooperation on the Biodiversity and Forest Fire (2001).
KOREA	Agreement for Collaborative Research to develop a Korean Greenhouse Gas Emission Model. Korean Energy Economics Institute (1994).
	Implementing Arrangement between the National Institute for Environmental Studies of Japan and the National Institute of Environmental Research of the Republic of Korea to establish a cooperative framework regarding environmental protection technologies (1988, and revised in 1994).
	Implementing Agreement between Naitonal Institute for Environmental Studies of Japan and National Insititute of Environmental Research of the Republic of Korea to establish a cooperative frameword regarding endocrine disrupting chemicals research (1999).
MALAYSIA	Memorandum of Understanding between the Forest Research Institute Malaysia (FRIM), the University Pertanian Malaysia (UPM) and the National Institute for Environmental Studies, Japan (NIES) for Collaborative Research on Tropical Forests and Biodiversity (1991, and revised in 1995).
RUSSIA	Agreement on a Joint Geochemical Research Program; Impact of Climatic Change on Siberian Permafrost Ecosystems between the Permafrost Institute, Siberian Branch, Russian Academy of Sciences, Russia and the National Institute for Environmental Studies, Japan (1992).

Agreement on a Cooperative Research Project between the Central Aerological Observatory, Committee for Hydrometeorology and Monitoring of Environment, Ministry of Ecology and Natural Resources, Russian Federation and the National Institute for Environmental Studies, Japan (1992).

Agreement on Cooperative Research Projects between National Institute for Environmental Studies, Environment Agency of Japan and Institute of Atmospheric Optics, Russian Academy of Sciences (1997).

Agreement on Cooperative Research Project between Institute of Solar-Terrestrial Physics (ISTP), Siberian Branch, Russian Academy of Science and National Institute for Environmental Studies, Environment Agency of Japan.

THAILAND Memorandum of understanding between Kasetsart University, Bangkok, Thailand and National Institute for Environmental Studies, Japan (NIES) for collaborative research on microalgal and protozoan biochemistry and toxicology, systematics and diversity, and application (1995).

UN Memorandum of Understanding referring to the establishment and operation of a GRID-compatible Centre in Japan (1991).

<Host Division>

Researcher, COUNTRY, Research Period
Research Subjedt (Host Researcher)

<Office of International Coordination>

Chen, Suying, CHINA, 2001. 3. 1~2001. 6. 9
Study on the physiological characters of crops in high concentration of carbon dioxide (Shimizu, H.)

Feng, Yanwen , CHINA, 2001. 4. 1~2002. 3. 31
Research on decline of Betula ermanii related to some environmental factors (Shimizu, H.)

Qiu, Guo Yu, CHINA, 2001. 7. 16~2002. 3. 31
Studies on the development of indicators for assessment and monitoring of desertification (Shimizu, H.)

Thy, Sum, CAMBODIA, 2001. 7. 2~2002. 3. 31
Improving the accuracy of greenhouse gas emissions from industry and agriculture sectors (Shimizu, H)

Zheng, Yuanrun, CHINA, 2001. 7. 27~2002. 3. 31
Evaluation of countermeasures to rehabilitate desertificated lands (Shimizu, H.)

<Social and Environmental Systems Division>

Baruah, Pranab Jyoti, INDIA, 2001. 6. 26~2002. 3. 31
Water quality measurements of Lake Kasumi-ga-Ura by remote sensing (Tamura, M.)

Chen, Jin, CHINA, 2001. 6. 11~2002. 3. 31
Modeling and sustainable management of ecosystems in East Asia river basins (Tamura, M.)

Gielen, Dolf Jean, THE NETHERLANDS, 2000. 10. 1~2002. 2. 25
Modeling of global environmental burdens by economis activities using energy and material flow analysis (Moriguchi, Y.)

Jung, Taeyong, KOREA, 2001. 8. 1~2002. 3. 31
Development of CO_2 emission model in Korea (Morita, T.)

Pandey, Rahul, INDIA, 2002. 1. 07~2002. 3.31
Development of model, database and framework for environmental innovation strategy in Asia-Pacific region (Kainuma, M.)

Rana, Ashish, INDIA, 2000. 5. 23~2002. 3. 31
Model assessment of macro-economic effect of environmental industries (Morita, T.)

Yang, Cuifen, CHINA, 2001. 3. 1~2002. 3. 31
Investigation of land-use danges and driving forces in Liao Delta China (Tamura, M.)

Yang, Hong-Wei, CHINA, 2001. 8. 17~2002. 3. 31
International collaborative studies for evaluating the effects of CDM (Clean Development Mechanism) (Kainuma, M.)

Yang, Jianxin, CHINA, 2002. 3. 25~2002. 3. 31
Life cycle management of municipal solid wastes and recycling strategies (Moriguchi, Y.)

You, Songcai, CHINA, 2001. 5. 15~2001. 9. 30
Development of assessment model for climate change impact on agriculture in china (Morita, T.)

<Environmental Chemistry Division>

Chowdhury, A. Z. M. Shaifullahmr, BANGLADESH, 1999. 10. 1~2001. 9. 30
Arsenic speciation in the environment: in context of Bangladesh (Shibata, Y.)

Ma, Wanhong, CHINA, 2001. 12. 12~2002. 3. 11
Studies on intermediary species in chemical processes and flame (Fujii, T.)

Selvin, Panneer Christopher, INDIA, 2000. 5. 15~2002. 2. 14
Computor science of production reaction and toxicity index of dioxins (Fujii, T.)

Sundram, Arulmozhiraja, INDIA, 1998. 8. 1~2002. 3. 31
Structure, energy and reaction of Dioxin (Fujii, T.)

Zheng, Jian, CHINA, 2001. 3. 1~2002. 3. 31
Development of hyphnated technique for multi-element speciation analysis and its application to biological, medical and environmental sciences (Shibata, Y.)

<Environmental Health Sciences Division>

Bai, Yushi, CHINA, 2000. 4. 1~2002. 2. 28
Reconstruction of human pulmonary endothelial tissue in vitro (Mochitate, K.)

Lee, Jae-Seong, KOREA, 1999. 10. 10~2001. 9. 2
Development of transgenic zebrafish for detecting mutagens. (Aoki, Y.)

Munidasa, Dulee, SRI LANKA, 2001. 11. 6~2002. 3. 31
Effect of diesel exhaust on antigen presenting activity of lung in rats (Kobayashi, T.)

Shraim, Amjad, AUSTRALIA, 2000. 4. 4~2002. 1. 20
Speciation of arsenic in environmental samples (Hirano, S.)

<Atmospheric Environment Division>

Bellis, David John, U. K, 2001. 3. 29~
Historical monitoring using bark pockets as pollution time capsules (Satake, K.)

Bin, Qi, CHINA, 2002. 1. 17~
Studies on the peroxide-formation mechanisms in the photochemical reactions of hydrocarbons (Hatakeyama, S.)

Chen, Yan, CHINA, 2001. 8. 7~2001. 12. 6
Study of transport of asian dust aerosol using lidar and optical measurement methods (Sugimoto, N.)

Loukianov, Alexandre, RUSSIA, 2001. 5. 22~
Study on ozone depletion using the photochemical model (Nakane, H.)

Patroescu-Klotz, Iulia Varelia, ROMANIA, 2001. 4. 1~2002. 3. 31
Studies on the photochemical reactions of organic sulfur compounds (Hatakeyama, S.)

Shin, Jawa, CHINA, 2001. 6. 12~2002. 3. 31
Study on mixing processes in the Arctic region after polar vortex breaking (Nakane, H.)

Yang, Hyung Jae, KOREA, 2001. 10. 4~2002. 3. 31
Reconnaissance study on the Water Quality of Miomotegawa River in Niigata Prefecture for the evaluation of the impacts of acid pollution (Satake, K.)

Zhang, Jiahua, CHINA, 1999. 7. 1~2001. 6. 30
Study on modeling of carbon exchange processes at the land surface (Kanzawa, H.)

<Water and Soil Environment Division>

Kim, Yong-Hwan, KOREA, 2001. 3. 20~2002. 3. 19
Characterization of dissolved organic matter in lake water (Imai, A.)

Yang, Yonghui, CHINA, 2000. 3. 1~2002. 2. 28
Effect of temperature and precipitation on soil moisture and biomass production in China (Watanabe, M.)

Zhang, Jiqun, CHINA, 2001. 4. 1~2002. 3. 31
Estimation of the environmental load flowing into the East China Sea from the Changjiang River basin (Watanabe, M.)

<Environmental Biology Division>

Bathula, Srinivas, INDIA, 2002. 2. 15~
Molecular cloning and characterization of ozone-tolerant genes using ozone-sensitive *Arabidopsis* mutants (Kubo, A.)

Chonudomkul, Duenrut, THAILAND, 2001. 6. 12~2002. 3. 31
Taxonomy and systematics of Cylindrospermopsis (Cyanobacteria) based on molecular and traditional approaches (Watanabe, M. M.)

Cui, Xiaoyong, CHINA, 2001. 7. 10~
Combined effects of temperature and radiation on leaf photosynthesis of alpine grassland plants on Qinghai-Tibet Plateau (Tang, Y.)

Gu, Song, CHINA, 2001. 7. 9~
A study on CO_2, H_2O and energy fluxes in an alpine grassland ecosystem on Qinghai-Tibet Plateau (Tang, Y.)

Hehmann, Anett, GERMANY, 1999. 7. 1~2001. 6. 30
Selective control of toxic cyanobacteria and detoxication of toxic compounds, microcystins using bacteria and algicides (Watanabe, M. M.)

LEE Jaeseok, South Korea, 2002. 7. 1~
Evaluation of soil carban storage in an alpine meadow (Tong, Y.)

<Climate Change Research Project>

Zhou, Lingxi, CHINA, 2002. 3. 1~2002. 3. 31
Study on CO_2 observation system in the Asian region (Mukai, H.)

<Ozone Layer Research Project>

Klotz, Björn, GERMANY, 1999. 10. 15~2001. 9. 30
Studies on atmospheric oxidation processes of aromatic hydrocarbons (Imamura, T.)

Oshchepkov, Sergey, RUSSIA, 2001. 7. 16~2002. 3. 31
A study on analytical method for ILAS-II validation experiments (Nakajima, H.)

Rivière, Emmuanuel, FRANCE, 2001. 10. 15~2002. 3. 31
A study on polar stratospheric chemistry using a Lagrangian photochemical model and balloon-borne measurements (Nakajima, H.)

Zhou, Libo, CHINA, 2002. 3. 1~2002. 3. 31
A study on ozone Transport processes using a chemical transport model (Akiyoshi, H.)

<Endocrine Disrupters and Dioxin Research Project>

Jia, Guang, CHINA, 2000. 2. 1~2002. 1. 31
Mechanistic study of heavy metal-induced carcinogenesis (Sone, H.)

Sarkar, Poonam, INDIA, 2000. 4. 1~2002. 3. 31
Effect of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin on aromatase activity in rats (Yonemoto, J.)

Xu, Xiaobin, CHINA, 2002. 1. 28~2002. 3. 31
A study on the neuro-behavioral effects of endocrine disrupting chemicals on rat fetus (Imai, H.)

<Research Center for Material Cycles and Waste Management>

Bhaskaran, Krishnakumar, INDIA, 2000. 10. 1~
Control of excess biomass production in activated sludge system by increased non growth energey dissipation mechanisms (Inamori, Y.)

Dass, Preeti, INDIA, 2001. 4. 1~
Study on the operation and management techniques to control CH_4 and N_2O for the natural wastewater treatment process using soil and vegetation (Inamori, Y.)

Ding, Guoji, CHINA, 2001. 6. 25~
Development of advanced biological wastewater treatment system using specific protozoa and metazoa based on ecological engineering (Inamori, Y.)

Gui, Ping, CHINA, 2001. 4. 1~
Study on the operation and management techniques to control CH_4 and N_2O for the constructed wetland system (Inamori, Y.)

Jeong, Seung Mi, KOREA, 2001. 7. 19~2002. 3. 31
Washing technology for reduction and stabilization of pollutans in MSW incineration residues (Osako, M.)

Jiang, Ruiying, CHINA, 2001. 6. 12~
Study on the physicochemical environmental factor's influencing to polysaccharide-formation of microcystis species (Inamori, Y.)

Kim, Jeong-Sook, KOREA, 1999. 11. 1~
Effects of immobilized Alcaligenes faecalis on Nitrous Oxide Emission and Nitrogen Removal in Municipal Wastewater Treatment (Inamori, Y.)

Li, Xianning, CHINA, 2001. 6. 25~
Development of resource cycling water purifiation system using aquatic plant (Inamori, Y.)

Shekdar, Ashok Vishnupant, INDIA, 2001. 10. 15~2002. 1. 14
Applicability of Japanese advanced technology of waste treatment to India (Yamada, M.)

Sun, Liwei, CHINA, 2001. 2. 1~
Study on the effects of the global climate changing gas on the abnormal growth of toxic algae and metabolic pathway in aquatic ecosystem (Inamori, Y.)

Wui, Seonguk, KOREA, 2001. 2. 27~
Evaluation of effect of agricultural chemicals on microcosm as aquatic model ecosystem (Inamori, Y.)

Yang, Jin-woo, KOREA, 2001. 3. 1~2002. 2. 28
A study on substance flows and material flows for hazardous chemicals in waste management (Inoue, Y.)

Yang, Yufang, CHINA, 2001. 6. 25~
Development on the effective treatment technology of sludge produced from domestic wastewater and lake water purification process (Inamori, Y.)

<Laboratory of Intellectual Fundamentals for Environmental Studies>

Gao, Yong, CHINA, 2001. 7. 16~2002. 3. 31
Evaluation of vegetation indicators for the monitoring and assessment of desertification. (Tobe, K.)

<Center for Global Environmental Research>

Alexandorov, Georgii Albertovich, RUSSIA, 2001. 4. 2~2002. 3. 31
Model of carbone so questration by forest (Inoue, G.)

Kim, Yoonjae, KOREA, 2001. 12. 27~
Derivation of aerosol properties using the ILAS and ILAS-II data, and retrieval of CO_2 mixing ratio using the ILAS-II data. (Yokota, T.)

Maksyutov, Shamill, RUSSIA, 2001. 7. 16~2002. 3. 31
Development of CO_2, CH_4 flux numerical model "Flux model of Greenhouse Gases" (Inoue, G.)

Metternicht, Graciela Isabelle, AUSTRALIA, 2001. 8. 15~2001. 9. 24
Land use mapping and change detection using multi-sale and source remote sensing data (Yamagata, Y.)

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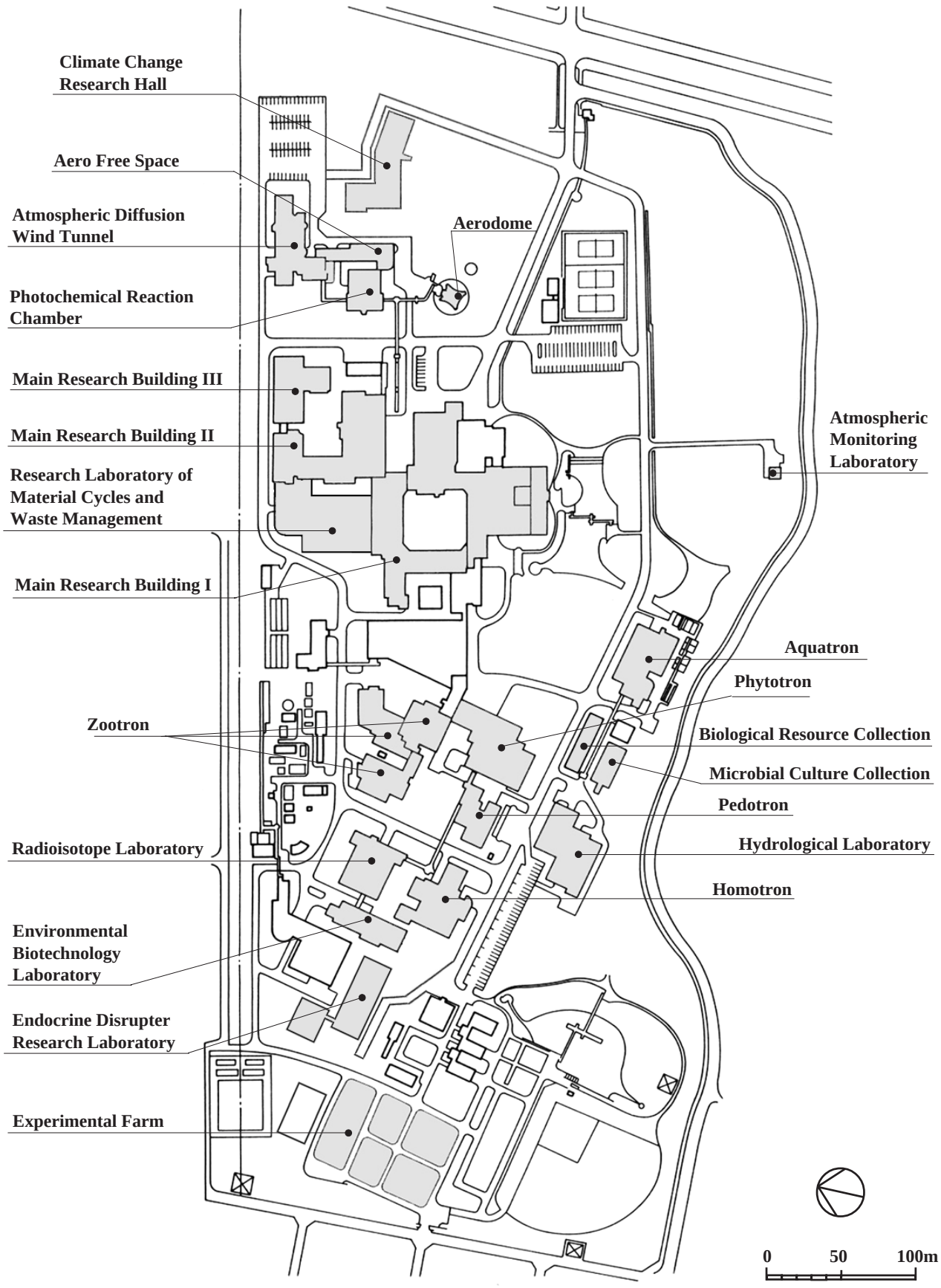
Climate Change Research Hall
Aero Free Space
Atmospheric Diffusion Wind Tunnel
Photochemical Reaction Chamber
Main Research Building III
Main Research Building II
Research Laboratory of Material Cycles and Waste Management
Main Research Building I
Zootron
Radioisotope Laboratory
Environmental Biotechnology Laboratory
Endocrine Disrupter Research Laboratory
Experimental Farm
Aerodome
Atmospheric Monitoring Laboratory
Aquatron
Phytotron
Biological Resource Collection
Microbial Culture Collection
Pedotron
Hydrological Laboratory
Homotron
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Aerodome
The aerodome is a facility both for remote monitoring of pollutant particles in the atmosphere (via a large-scale laser radar) and for study of the formation of secondary particulates from gaseous primary pollutants. The laser radar can scan rapidly and sensitively, with computer-controlled pointing, both tropospheric and stratospheric aerosols at any angle above the horizon. The 4-m^3 aerosol chamber can be evacuated to 10^{-5} Torr.

Aero Free Space
The aero-free-space laboratory serves as the site for instrument calibration for both laboratory and field experiments. It is also available for atmospheric research that cannot be done in any of the other atmospheric research facilities.

The ozone laser radar is equipped with 3 lasers of different wavelengths and 56- and 200-cm caliber telescopes. Accurate ozone profiles up to an altitude of 45 km are being measured with this instrument.

Aquatron
This hydrobiological laboratory includes several related special facilities. The freshwater microcosm is particularly suitable for studies of the mechanisms of phytoplankton bloom formation and dynamics. The toxicity testing system is suitable for long-term exposure studies. Other associated facilities include temperature-controlled culture rooms, axenic culture rooms, large autoclaves and an outdoor experimental pond.

Atmospheric Diffusion Wind Tunnel
This wind tunnel is exceptional in that wind velocities (down to 0.2 m s^{-1}), air temperatures and floor temperatures can be independently controlled to create stratified flow fields. Temperature and wind velocity sensors are moved through the tunnel on a computer controlled traverse system gathering 3-dimensional data. These features, together with the use of models of buildings or mountains in the tunnel, allow accurate simulation of air flow and pollutant transport under a variety of atmospheric conditions.

Atmospheric Monitoring Laboratory
Automatic instruments to monitor the concentrations of 7 atmospheric constituents (NO_x, SO_2, O_3, CO_2, non-methane hydrocarbons, suspended particulate matter and gaseous Hg) are operated in this facility. Wind speed, precipitation, atmospheric pressure, visible and UV radiation, earth surface (soil and air) temperature and other atmospheric characteristics are also measured and the results made available to NIES researchers. The stability and accuracy of the automated measurements and factors that interfere with them are studied.

Bio/Eco-Engineering Research Facility
Improving water quality in enclosed water bodies is an important environmental issue in many places around the world. If water-cleaning technologies are used, it is essential that they be properly suited to the local conditions. NIES constructed a new facility for research, development, and actual field testing of new types of innovative waste and wastewater treatment systems such as advanced johkasou, aquatic plant-soil application processes that use bio-and eco-engineering technologies. The new facilities will enhance research activities, including international cooperative research.

Biological Resource Collection
In order to enhance research relating to microbes that are important for environmental studies such as hazardous substance decomposing microbes, and to preserve experimental materials for conservation studies, a new building is being constructed as an annex of the Microbial Culture Collection Building at NIES. The new facilities consist of rooms for cryopreservation, identification and classification, evaluation of functions, genetic analysis, and databases of environmental microbes.

Climate Change Research Hall
Climate Change Research Hall (CCRH), built especially for global warming research, was completed in March 2001 with 3 floors and 4,900m^2 total area. The following major research programs are conducted in this new facility: (1) development and implementation of the climate change models based on various socio-economic and emissions scenarios, (2) monitoring of atmospheric constituents to evaluate the ocean and terrestrial carbon sinks, and (3) assessment of forest sinks by remote sensing, forest models and statistical data. In addition, the facility includes equipment to evaluate low emissions vehicles. CCRH was constructed various new energy saving. The effectiveness of energy saving is being monitored and analyzed.

Endocrine Disrupter Research Laboratory
The Endocrine Disruptor Research Laboratory was founded in March 2001 for studies on the analysis, bioassay, and experimental hazard/risk assessment of endocrine disrupting chemicals (EDCs), as well as for carrying out field surveys and assessing management technologies for these substances. The building is of 4 floors with a total area of 5,200m^2, and is equipped with several special instruments including a high-resolution nuclear magnetic resonance imaging (MRI) instrument (800MHz) for examining the activity of the living human brain, and liquid chromatography-tandem mass spectrometry (LC/MS/MS) for the qualitative and quantitative analysis of EDCs. The laboratory has all necessary basic laboratory functions for chemical and biological research on EDCs and is also intended to strengthen research collaboration with domestic and overseas researchers for the further development of research on endocrine disruptor.

Environmental Biotechnology Laboratory
The Environmental Biotechnology Laboratory is used to develop applications of recombinant-DNA technology for environmental protection and to study the fate and effects of recombinant organisms in ecosystems. This laboratory was completed in FY 1993. The specialized instruments of the laboratory, including a peptide sequencer and a DNA sequencer, are actively used.

Experimental Farm
The institute's experimental farm is 4 km west of the main grounds. The farm's facilities include a cultivated field, an experimental field, lysimeters, a greenhouse, a tool storage shed, an observation tower, a remnant natural forest and offices. This farm serves to test results obtained in the indoor controlled-environment biological laboratories of the Institute; to evaluate the environmental maintenance functions of plant and soil ecosystems; and to supply plant material, particularly for use in bioassays and bioremediation, to researchers at the Institute.

Global Environmental Monitoring Stations (Hateruma and Cape Ochi-ishi)
These Monitoring stations were set up mainly to monitor the long-term changes in baseline level of global-warming gases at sites where the effect of urban air pollution is virtually negligible. Hateruma Station is located in Okinawa Prefecture, on the eastern edge of Hateruma Island, the nation's southernmost inhabited island. This site is suited for monitoring the baseline atmosphere over the subtropical Pacific Ocean. Cape Ochi-ishi Station is located in Hokkaido Prefecture, at the tip of Cape Ochi-ishi, which is located at the root of Nemuro Peninsula. This site is suited for monitoring the baseline atmosphere over the Pacific Ocean in summer and over Siberia in winter. These stations are automated systems for high-precision monitoring of global-warming gases and other atmospheric species; human attendance is not required.

Homotron
This laboratory includes a variety of facilities to evaluate pollution effects on community health. The Noise Effects Laboratory has one anechoic room and three sound-proof rooms for testing the psycho-physiological effects of noise on health. The Community Health Laboratory provides facilities for epidemiological studies on humans and experimental studies on animals to evaluate the effects of environmental pollutants.

Hydrological Laboratory
The facilities of this unit facilitate study of groundwater transport and coastal water quality. A large ocean microcosm is uniquely equipped to permit culture of marine algae and studies of CO_2 dynamics and elemental cycles.

Lake Kasumigaura Water Research Station
This field station, located on the shore of Lake Kasumigaura, is used as a common facility by many NIES researchers. The station's location allows *in situ* studies of pollution, water quality recovery, lake ecosystem dynamics and material cycles in this heavily eutrophied and polluted lake.

Main Research Building I
This building houses analytical instrumentation and support facilities such as clean rooms. The instruments permit accurate, highly sensitive and selective detection of harmful substances in environmental samples. Stable isotope analysis facilitates research on global warming and the origins of pollutants. Among this building's instruments, listed below, are some that are used for research and development of new analytical methods.

Table of Analytical Instrumentation in Main Research Building I

Standard Instruments (Free Access to Institute Researchers)
Gas Chromatograph/Mass Spectrometer
Gas Chromatograph with Atomic Emission Detector
Scanning Electron Microscope
Transmission Electron Microscope
Ultraviolet-Visible Microscope Spectrophotometer
Inductively Coupled Plasma Emission Spectrometer
Atomic Absorption Spectrometer
X-ray Fluorescence Spectrometer
X-ray Photoelectron Spectrometer
Stable Isotope Mass Spectrometer (for gas samples)
Fourier Transform Infrared Spectrometer
Nuclear Magnetic Resonance Spectrometer
Flow Cytometer
High-Speed Amino Acid Analyzer

Special Instruments (Restricted Access)
Gas Chromatograph/Mass Spectrometer
High-Performance Liquid Chromatograph/Mass Spectrometer
Inductively Coupled Plasma Mass Spectrometer
Secondary Ion Mass Spectrometer
High-Resolution Mass Spectrometer
High-Precision Stable Isotope Mass Spectrometer (for gas samples)
Thermal (Surface) Ionization Mass Spectrometer (for stable isotopes)
Atmospheric Pressure Ionization Mass Spectrometer
Laser Raman Spectrometer
X-ray Diffractometer

Main Research Building II
1) Evaluation Laboratory of Man-Environmental Systems (ELMES) and Systems Analysis and Planning in Intelligent Environmental Information Systems (SAPIENS)

ELMES includes a medium-sized conference room that serves as a group laboratory, a multi-group laboratory for gaming simulations, and minicomputer control devices for experiments, all to facilitate the experimental evaluation of human attitudes toward the environment, the environmental planning process and the effect of environmental information on these. SAPIENS is comprised of an environmental database, an image processing and display system and a minicomputer for presenting environmental information in ELMES. SAPIENS is also used to develop and study local environmental information systems.

2) Preservation Laboratory

This facility includes -20°C, 4°C and 25°C temperature-controlled rooms, a room for -100°C and -80°C freezers and a room for archives. Environmental specimens are stored here for long periods. Research on specimen preservation is also conducted.

Main Research Building III
1) Fourier-Transform Mass Spectrometer (FT-MS)

FT-MS has very high mass resolution, more than 10^6 at m/z = 131, with a superconducting magnet rated at 3 Tesla. Cluster ions with high mass numbers, isotopes/isobars, and reactions of radicals and ions can be measured with very high mass resolution.

2) Tandem Mass Spectrometer (Tandem-MS)

Two double-focus type mass spectrometers, each with a resolution of 6.5×10^4, are connected serially (in tandem). The ions selected by the first mass spectrometer are modified by electron impacts and other reactions in the interface area and the resulting ions are analyzed by the second mass spectrometer. The chemical structures of complex molecules can be analyzed with this technique.

3) Accelerator Mass Spectrometer (AMS)

An electrostatic tandem accelerator of 5 million V (max.) terminal voltage is interfaced with two ion sources and an analytical mass spectrometer system. Isobaric atomic ions can be distinguished by the electric charges of their nuclei. The AMS is a very sensitive

and selective method for atomic ion detection and it is used for measurements of long-lived radioisotopes such as ^{14}C and ^{36}Cl. These radioisotopes are used as tracers and time-markers (dating agents) in environmental research.

4) Hazardous Chemicals Area

Highly toxic substances, such as dioxins (chlorinated dibenzodioxins), polychlorinated biphenyls (PCBs) and polychlorinated dibenzofurans, are used in this area. The air pressure inside the area is maintained below atmospheric pressure, which prevents toxic fumes from leaking out. Exhaust air is treated by high-performance filters (HEPA) and charcoal filters; discharge water is also treated with a charcoal filter system. These filters and other wastes are destroyed by appropriate incineration facilities installed within the area. The Hazardous Chemicals Area contains a gas chromatograph/mass spectrometer (GC/MS) and a microcosm, as well as facilities for microorganism-related research, animal exposure experiments and measurements of the physical and chemical properties of substances.

5) Data Handling Facility for the Improved Limb Atmospheric Spectrometer (ILAS) and the Retroreflector in Space (RIS)

ILAS and RIS are satellite-borne sensors for measuring atmospheric constituents, such as ozone, and were developed by the Environment Agency of Japan as components of the Advanced Earth Observing Satellite (ADEOS), named Midori after launching. In August 1996, ADEOS was launched by an H-II rocket from the Tanegashima Space Center of Japan. Data obtained by ILAS/RIS are processed, archived and distributed by NIES. The data handling facility includes a parallel processing computer system, a high-speed network system and software, optimized for processing the data from these satellite sensors.

6) Millimeter-wave Spectrometer System for Observation of Atmospheric Ozone

The millimeter-wave spectrometer is widely and extensively used in astronomical measurements of gaseous molecules in space. Ozone molecules in the stratosphere and mesosphere radiate millimeter-range radio waves. The spectrometer system was completed in October 1995, and since then has continuously monitored the vertical distribution of ozone (35~75 km altitude), except on rainy or heavily overcast days.

7) Eco-Office

This is an office area for evaluating energy-saving/solar-energy-utilizing equipment such as wall insulation, solar cells and a solar hot water supply system. Several types of solar cells, such as single-crystal, multi-crystal and amorphous types, are being compared under identical conditions. The hot water generated is used as the source for a heat-pump type air conditioner as well as for hot water faucets.

8) Reception and Processing Facility for NOAA Satellite Data

The Advanced Very High Resolution Radiometer (AVHRR) orbits the earth on a National Oceanic and Atmospheric Administration (NOAA, USA) satellite. This instrument monitors 5 electromagnetic radiation wavelength bands from the visible to the infrared region with high temporal resolution and a relatively medium spatial resolution (ca. 1 × 1 km). The NIES AVHRR facilities consist of 2 receiving stations—one at NIES, Tsukuba, and the other on the island of Kuroshima, Okinawa—and a data processing center at NIES.

9) Information Processing Center for GRID-Tsukuba

GRID-Tsukuba is a part of the Center for Global Environmental Research (CGER). The GRID information processing system was introduced at NIES in 1994. This system, which consists of a remote-sensing image processing system and a geographic information system, is operated by NIES researchers to process GRID data and to produce original data sets. The work stations of this system are connected to a supercomputer, super-minicomputer and personal computers through a LAN. Several software packages, including ERDAS/IMAGINE, ARC/INFO and GRASS, are installed on these workstations. Image processing is done with IDRISI on an IBM/PC.

Microbial Culture Collection
This facility collects, characterizes, cultures and distributes strains of microorganisms. Many of the strains in the collection are important for the study of red tides and other phytoplankton blooms (including toxic algae), bioremediation, pollution bioassays and carbon cycling.

Oku-Nikko Field Monitoring Station
The field station in Oku-Nikko, Tochigi Prefecture, consists of an observatory and a control building. These facilities are used to both monitor background forest pollution levels and study the effects of pollution on the forest.

Pedotron
This is the soil laboratory, which contains large lysimeters, special growth chambers for studies of pesticide and heavy-metal effects, and soil-temperature-controlled chambers. Growth effects of pollutants and reclamation of contaminated soil are also studied.

Photochemical Reaction Chamber
This is a 6-m^3 stainless steel chamber that permits studies of atmospheric photochemistry at pressures as low as 10^{-7} Torr. This facility is essential to our research on the photochemistry of urban smog, stratospheric ozone depletion, and other important atmospheric phenomena.

Phytotron
The botanical laboratory complex consists of two major facilities to evaluate the effects of various detailed environmental scenarios on plants and soils. Both facilities include experimental chambers in which light, temperature and humidity can be precisely controlled. Facility I also facilitates exposure of the experimental plants and soils to pollutant gases under these controlled conditions. Facility II has 2 simulators that permit the creation of micro-environments stratified from the soil up through the overlying atmosphere.

Radioisotope Laboratory
In this laboratory, radioisotopes are used to facilitate studies of the transport, accumulation, chemical conversion and toxicity of environmental pollutants in plants, animals, soil, water and the atmosphere. The use of 36 β and γ emitting isotopes is permitted, but the use of α emitters is forbidden.

Research Laboratory of Material Cycles and Waste Management

In April 2001 NIES established the Research Center for Material Cycles and Waste Management, as an expansion of the Waste Research Division that had been create in January in connection with national government's administrative reforms. Research Laboratory of Material Cycles and Waste Management supports research on resource circulation and waste management, resource recovery and recycling, and technologies for environmental risk reduction and restoration after pollution, as well as testing, evaluation and monitoring.

Rikubetsu Stratospheric Monitoring Station

NIES has carried out the monitoring of the stratospheric ozone layer over Hokkaido in collaboration with Solar-Terrestrial Environment Laboratory (STEL) in Nagoya University. Also, the monitoring has been made in a room of the Rikubetsu Astronomical Observatory administered by Rikubetsu town. The center has taken various systems to monitor, including vertical distribution of stratospheric ozone measured by Millimeter-wave radiometer, observation of harmful ultraviolet rays monitored by Brewer spectrometer and vertical temperature distribution of stratospheric ozone monitored by laser radar. The aim is to reveal the ozone depletion in the stratosphere and the effects of "Arctic ozone hole". Since parts of the polar vortex in the Arctic region sometimes arrive over Hokkaido in winter/spring, Rikubetsu is one of the sites to study the effects of the Arctic polar vortex.

Tomakomai Flux Research Site

The main research objectives are to develop and evaluate the observation systems for measurement of fluxes of CO_2 and energy in woodland ecosystem at Tomakomai National Forest in Hokkaido. The comprehensive research has carried out continuous monitoring in larch forest to elucidate carbon cycle function such as CO_2 flux. With the cooperation of universities, national research institutes, regional government and Hokkaido Regional Forest Office as a main site, the observation has been implemented.

Zootron

The animal laboratory has two facilities, in which environmental conditions are controlled. Facility I breeds conventional and specific pathogen-free laboratory animals and has complex gas exposure chambers. Facility II also has a conventional laboratory-animal breeding unit and is useful for studies of the effects of heavy metals and residual chemical exposure. The Nuclear Magnetic Resonance Imager (NMRI) for living organisms images living bodies and active metabolic functions of humans and animals.

Present Number of Personnel

President	1
Executive Director	2
Auditor	2
Research Coordinators	7
Audit Section	2
General Affairs Division	36
Executive Investigator	1
Principal Investigator	1
Social and Environmental Systems Division	21
Environmental Chemistry Division	14
Environmental Health Sciences Division	16
Atmospheric Environment Division	22
Water and Soil Environment Division	14
Environmental Biology Division	15
Climate Change Research Project	1
Ozone Layer Research Project	4
Endocrine Disrupters & Dioxin Research Project	13
Biodiversity Conservation Research Project	11
Watershed Environments and Management Research Project	8
PM2.5 & DEP Research Project	11
Research Center for Material Cycles and Waste Management	24
Research Center for Environmental Risk	6
Environmental Information Center	14
Laboratory of Intellectual Fundamentals for Environmental Studies	6
Center for Global Environmental Research	9
Total	261

Fields of Expertise

Basic Sciences	83
Engineering	61
Agricultural Sciences	21
Medical Science	18
Pharmacology	4
Fisheries Science	2
Economics	3
Total	192

Division / Section/Team	Position	Staff Menber	Extension	E-mail (@nies.go.jp)
Headquarters				
	President	GOHSHI, Yohichi	2300	gohshi
	Executive Director (Research)	NISHIOKA, Shuzo	2301	snishiok
	Executive Director (Management)	HAMADA, Yasutaka	2820	yhamada
	Auditor	TOMIURA, Azusa	2822	tomiura
	Auditor	OTSUKA, Hiroshi	2823	hotsuka
Research Coordinators				
	Principal Research Coordinator	TAKAGI, Hiroaki	2302	htakagi
	Deputy Director (∗)	OTSUBO, Kuninori	2827	kuninori
Office of Research Coordination & Public Relations				
	Chief	TAKIMURA, Akira	2453	takimura
	Research Coordinator	YASUDA, Naoto	2303	nyasuda
	Research Coordinator	KORESAWA, Yuji	2304	koresawa
	Research Coordinator	SUGIYAMA, Kenichirou	2307	kensugi
	Research Coordinator (∗)	SAKAMAKI, Fumio	2305	fsakamak
	Research Coordinator (∗)	SUGAYA, Yoshio	2306	sugaya
Office of International Coordination				
	Chief (∗)	OTSUBO, Kuninori	2827	kuninori
	International Coordination Researcher	SHIMIZU, Hideyuki	2309	hshimizu
	International Research Coordinator	HIROKANE, Katsunori	2308	hirokane
Audit Section				
	Chief (∗)	ONISHI, Shigeru	2312	sonishi
General Affairs Division				
	Director	OZAWA, Norio	2311	n-ozawa
General Affairs Section				
	Chief	ONISHI, Shigeru	2312	sonishi
Accounting Section				
	Chief	OTSUKA, Tetsuya	2319	t-otsuka
Facility Management Section				
	Chief	USUKI, Tamio	2325	usuki
Executive Investigator				
		MORITA, Masatoshi	2332	mmorita
Principal Investigator				
		KABUTO, Michinori	2333	kabuto
Social and Environmental Systems Division				
	Director	MORITA, Tsuneyuki	2541	t-morita
	Deputy Director	TAMURA, Masayuki	2479	m-tamura
	Independent Senior Researcher	AOKI, Yoji	2389	yojiaoki
	Independent Senior Researcher	OTOMA, Suehiro	2420	otoma
Environmental Economics Section				
	Leader (∗)	MORITA, Tsuneyuki	2541	t-morita
		AOYAGI, Midori	2392	aoyagi
		HIBIKI, Akira	2510	hibiki
		KAMEYAMA, Yasuko	2430	ykame
Resources Management Section				
	Leader	MORIGUCHI, Yuichi	2540	moriguti
		MORI, Yasufumi	2539	mori-y
		TERAZONO, Atsushi	2506	terazono

(∗) Multiple roles

Environmental Planning Section			
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	TAKAHASHI, Kiyoshi	2543	ktakaha
	HIJIOKA, Yasuaki	2961	hijioka
Information Processing and Analysis Section			
Leader (∗)	YOKOTA, Tatsuya	2550	yoko
	SUGA, Shinsuke	2456	sugas
	SHIMIZU, Akira	2452	ashimizu
	MATSUNAGA, Tsuneo	2838	matsunag
	YAMANO, Hiroya	2477	hyamano
Integrated Assessment Modeling Section			
Leader	KAINUMA, Mikiko	2422	mikiko
	MASUI, Toshihiko	2524	masui
	FUJINO, Junichi	2504	fuji
Environmental Chemistry Division			
Director (∗)	MORITA, Masatoshi	2332	mmorita
Independent Senior Researcher	YOKOUCHI, Yoko	2549	yokouchi
Analytical Instrumentation and Methodology Section			
Leader	UEHIRO, Takashi	2811	uehiro
	KUME, Hiroshi	2436	hkume
	NISHIKAWA, Masataka	2495	mnishi
Analytical Quality Assurance Section			
Leader	TANABE, Kiyoshi	2478	tanabe
	ITO, Hiroyasu	2398	h-ito
Environmental Chemodynamics Section			
Leader	SHIBATA, Yasuyuki	2450	yshibata
	KUNUGI, Masayuki	2434	kunugi
	SEYAMA, Haruhiko	2462	
	TANAKA, Atsushi	2476	tanako
	YONEDA, Minoru	2552	myoneda
Ecological Chemistry Section			
Leader (∗)	MORITA, Masatoshi	2332	mmorita
	HORIGUCHI, Toshihiro	2522	thorigu
	EDMONDS, John S.	2860	Edmonds.john.s
	IWANE, Taizo	2251	iwane
Environmental Health Sciences Division			
Director	TOHYAMA, Chiharu	2336	ctohyama
Deputy Director	KOBAYASHI, Takahiro	2353	takakoba
Molecular and Cellular Toxicology Section			
Leader	NOHARA, Keiko	2500	keikon
	OHSAKO, Seiichiro	2519	ohsako
	ISHIMURA, Ryuta	2397	ishimura
Environmental Biodefense Research Section			
Leader	FUJIMAKI, Hidekazu	2518	fujimaki
	MOCHITATE, Katsumi	2538	mochitat
	KUROKAWA, Yoshika	2437	kurokawa
	YAMAMOTO, Shoji	2548	snyamamo
	KAKEYAMA, Masaki	2767	kake
Biomarker and Health Indicator Section			
Leader (∗)	HIRANO, Seishiro	2512	seishiro
	XING, Cui	2892	xing.cui
Epidemiology and International Health Research Section			
Leader	ONO, Masaji	2421	onomasaj
	TAMURA, Kenji	2520	ktamura
	ARAGAKI, Tazusa	2916	tazusa
	MURAKAMI, Yoshitaka	2254	ymura

(∗) Multiple roles

Atmospheric Environment Division

Director	SASANO, Yasuhiro	2444	sasano
Deputy Director	NAKANE, Hideaki	2491	nakane
Independent Senior Researcher	MURANO, Kentaro	2537	murano
Atmospheric Physics Section			
Leader	KANZAWA, Hiroshi	2431	kanzawa
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	SUGATA, Seiji	2457	sugatas
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(*)	TAMURA, Kenji	2520	ktamura
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	FURUYAMA, Akiko	2521	kawagoe
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(∗)	ONO, Masaji	2421	onomasaj
(∗)	NAKANE, Hideaki	2491	nakane
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(∗)	TANAKA, Atsushi	2476	tanako

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ADEOS-II	Advanced Earth Observing Satellite-II
AGCM	Atmospheric General Circulation Model
AGP	Algal Growth Potential
CCSR	Center for Climate System Research, the University of Tokyo
CFCs	Chlorofluorocarbons
CMAQ	community multiscale air quality system
CRMs	Environmental Certified Reference Materials
CTM	Chemical Transport Model
DE	diesel exhaust
DEP	diesel exhaust particles
DGGE	Denaturing Grodient Gel Electrophoresis
DHF	Data Handling Facility
DMA	Dimethylarsinic Acid
DMI	Direct Material Input
DPO	Direct Processed Output
ECG	electrocardiogram
EDCs	Endocrine Disrupting Chemicals
ELISA	Enzyme-Linked Immuno Sorbent Assay
ETU	Ethylene-Thio-Urea
FTS	Fourier Transform Spectrometer
GC/HRMS	Gas Chromatography/High Resolution Mass Spectrometry
GC/MS	Gas Chromatography/Mass Spectrometer
GCM	general circulation model
GHG	greenhouse gas
GIS	Geographical Information System
H_2S	Hydrogen Sulfide
HF	high frequency power spectrum
ICAM-1	intercellular adhesion molecule-1
ICP/MS	Inductively Coupled Plasma/Mass Spectrometer
IL-1β	interleukin-1β
ILAS	Improved Limb Atmospheric Spectrometer
ILAS-II	Improved Limb Atmospheric Spectrometer-II
IPCC	Intergovernmental Panel on climate Change
LAN	Local Area Network
LC/ECD	Liquid Chromatography/Electric Conductivity Detector
LC/NCI/MS	Liquid Chromatography /Negative chemical Ionization/Mass Spectrometry
LF	low frequency power spectrum
MDPIOT	Multi-Dimesional Product Input and Output Table
MMA	Monomethylarsonic Acid
MOE	Ministry of the Environment
NASDA	National Space Development Agency of Japan
NDSC	Network for the Detection of Stratospheric Change
NMR	Nuclear Magnetic Resonance
PM2.5	particulate matter less than 2.5 microns
POPs	Persistent Organic Pollutants
SAGE-II	Stratospheric Aerosol and Gas Experiment-II
SH	spontaneously hypertensive
SOFIS	Solar Occultation Fourier Transform Spectrometer for Inclined-orbit Satellite
TCDD	Tetra-Cloro-Dibenzo-Dioxin
TEF	Toxic Equivalent Factor
TEOM	tapered element oscillating microbalance
UNEP	United Nations Environment Programme
UNIFAC	UNIQUAC Functional-group Activity Coefficients
VOC	volatile organic compounds
WHO	World Health Organization
WWW	World Wide Web

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