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NIES Annual Report 2001

National Institute for Environmental Studies

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Contents

Foreword

This is the final issue of NIES Annual Report. The National Institute for Environmental Studies (NIES) was transformed from a Japanese governmental research institute to an independent research agency in accordance with administrative reform of Japanese government. Though the name of NIES has been kept unchanged, its structure was reorganized completely. The new NIES has six research divisions, six special priority research projects, two policy response research centers and two groups of intellectual fundamentals for research. It also has several supporting divisions.

During the fiscal year 2000, all the members of NIES had extremely busy time related to this reorganization. Most research groups of NIES had to be reorganized and a new administrative system needed to be designed. I was afraid that their efforts to design a new system might have consumed a large part of research time and energy. Furthermore, two large research facilities (Climate Change Research Hall and Endocrine Disrupter Research Laboratory) were constructed after careful design work, which also needed extensive discussions. These efforts were also time consuming. Fortunately, however, my fear was useless. This annual report shows the productivity of our research staff is kept or even increased. I hope the next issue, which will bear the same title "NIES Annual Report 2002", though being compiled by the new NIES, will contain far enhanced research activities.

Y. Gohshi

Yohichi Gohshi
President

During the 1950s and 1960s, Japan experienced serious environmental pollution problems accompanying the rapid economic growth. Among these problems were 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. The Environment Agency of Japan was established in 1971 to develop countermeasures to serious environmental pollution problems such as these. 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 50 km north of Tokyo as a branch of the Environment Agency of Japan. NIES is the sole national institute for comprehensive research in the environmental sciences.

Since its establishment, NIES has conducted basic studies to reveal the nature of and to provide countermeasures to the so called seven common public nuisances; i.e. air pollution, water pollution, soil contamination, noise, vibration, offensive odor and ground subsidence. 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, the Okunikkou Field Monitoring Station and GHGs' Monitoring Station in Hateruma and Cape Ochi-ishi.

Recent, 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 (Fig. 1) 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 Principal Research Coordinator, the General Affair Division and the Environmental Information Center facilitate the research activities. The Environmental Information Center has the additional functions at preparing and providing access to both research publications and environment related data bases. The Environmental Training Institute, located in Tokorozawa, enhances the capabilities of officials from all levels of government.

As of the end of FY 2000, the total number of NIES regular personnel was 270 (Table 1). In FY 2000, NIES invited 383 scientists (7 foreigners included) to carry out the research programs as occasion demanded and also 182 researchers (70 foreigners included) joined NIES's research activities. The total budget of FY 2000 was 14,014 million yen (Table 2). 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. As 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 service to society.*
NIES will prepare a detailed 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.

Table 1
Full Number of Personnel

Research	179	66.3%
Management	44	16.3%
Env. Information Center	19	7.0%
Center for Global Env. Research	10	3.7%
Env. Training Institute	18	6.7%
Total	270	100%

(as of the end of FY2000)

Table 2
Budget in Millions of Yen

Item	FY1998	FY1999	FY2000	
1. Primary budget				(% of total)
Personnel	2,358	2,295	2,324	(19.3%)
Research	913	1,034	1,150	(9.6%)
Facilities operations & maintenance	1,457	1,616	1,615	(13.5%)
Info. & related research	549	558	561	(4.7%)
Center for Global Env. Research	2,652	2,679	2,440	(20.3%)
Env. Training Institute	198	213	457	(3.8%)
Administration	364	388	374	(3.1%)
Facilities maintenance and repairs	8,967	5,644	2,773	(23.1%)
Preparation for IAI			313	(2.6%)
Total	17,458	14,427	12,007	(100%)
2. Additional resources from external research funds				
EA Research Funds	1,528	1,403	1,318	
STA Research Funds and etc.	773	754	689	
Total	2,301	2,157	2,007	

(EA=Environment Agency, STA=Science and Technology Agency,
IAI=Independent Administrative Institution)

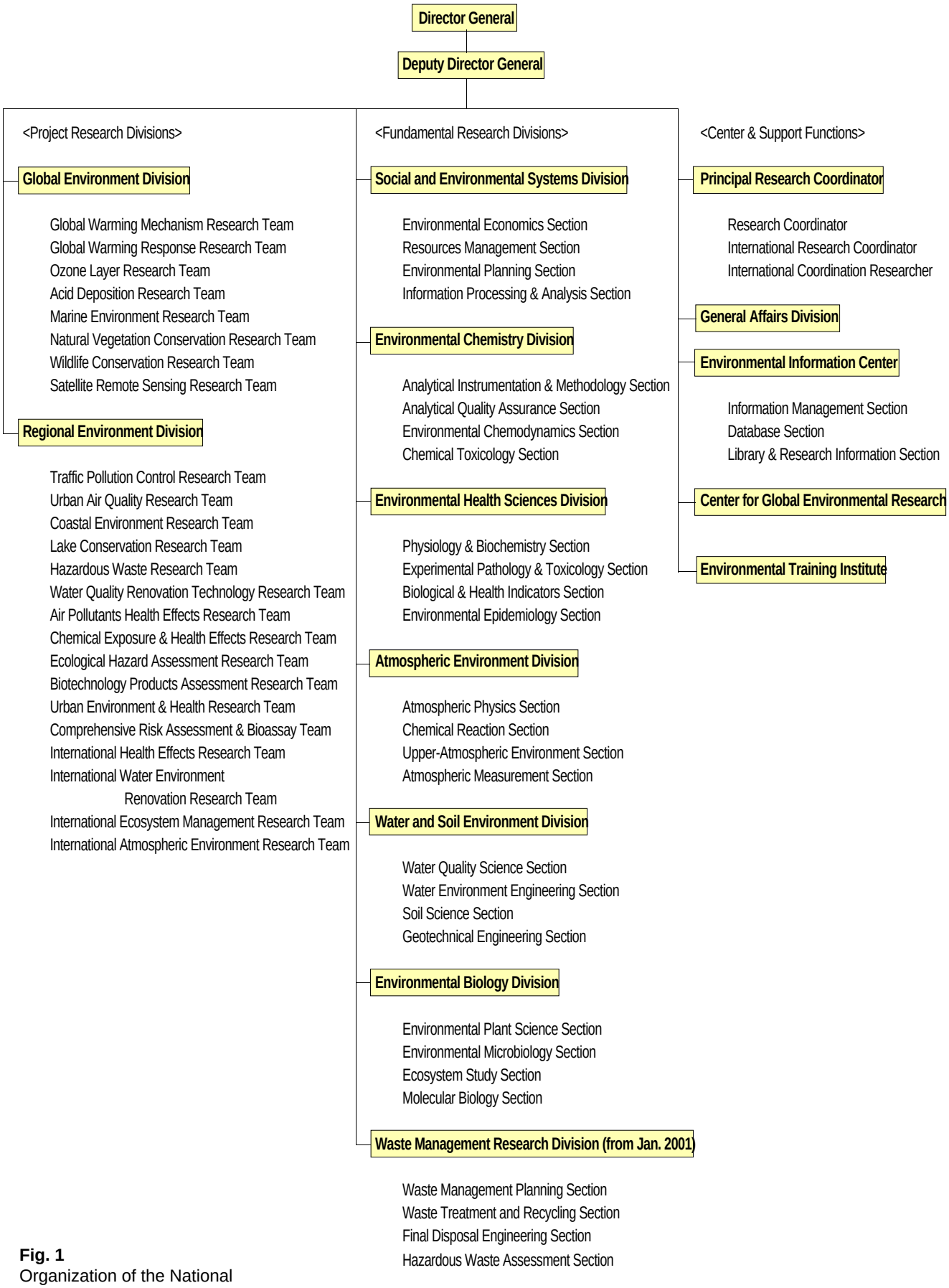
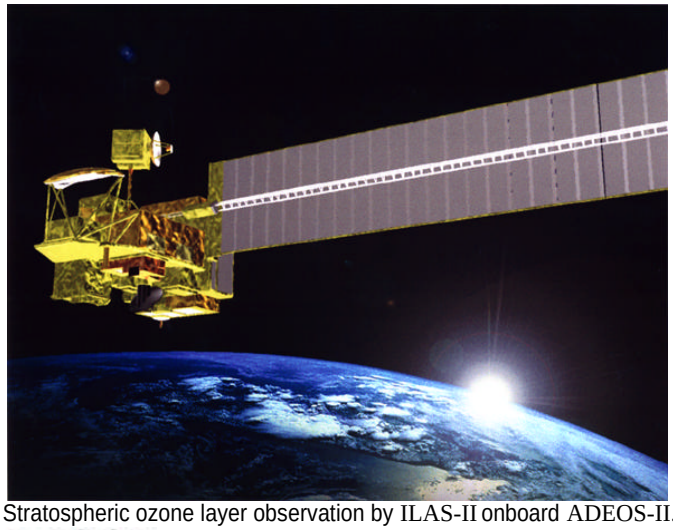
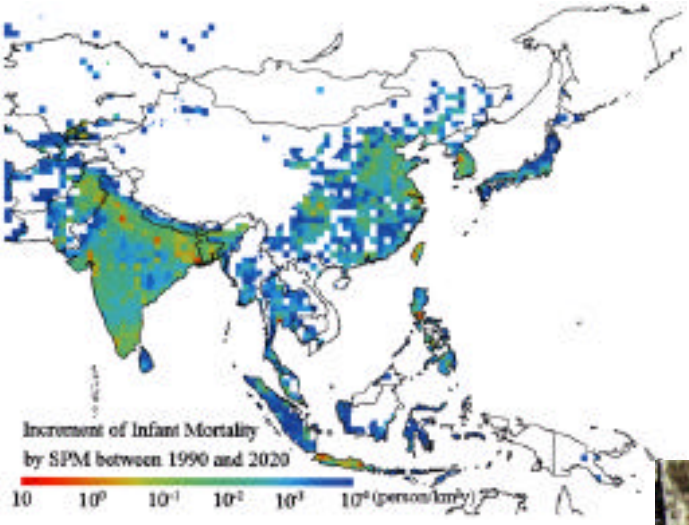


Fig. 1
Organization of the National Institute for Environmental Studies.

Global Environment Division



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



Tree census being conducted in the Pasoh Forest Reserve.

The Global Environmental Research Division consists of 9 research bodies concerned with current global environmental issues, such as global warming, acid deposition, ozone depletion, deforestation, and loss of biological diversity. Each team carries out research projects to provide a better understanding of the issues from technological, ecological, and sociological aspects. Using interdisciplinary and integrated approaches, our research findings contribute to our government's decision-making processes regarding global environmental problems. This report includes a brief introduction to the research activities of each team followed by details of recent findings from 3 of the teams.

Global Warming Mechanism Research Team

The Global Warming Mechanism Research Team is measuring greenhouse gases in the troposphere and the hydrosphere by utilizing the NIES monitoring network with various platforms established by CGER/NIES, including ground based stations, ships-of-opportunity, and aircraft. We have observed steadily increasing concentrations of atmospheric CO_2 at the 2 background air monitoring stations, located on Hateruma Island in Okinawa Prefecture and at Cape Ochiishi in Hokkaido Prefecture, since 1993 (Hateruma) and since 1995 (Ochiishi). Automated atmospheric bottle sampling systems for isotope measurements in CO_2 are installed in the stations since 1998. By comparing the results with the atmospheric oxygen concentration measured by the same sampling bottles, we estimate the natural carbon sink and source intensities of the ocean and land biosphere. During the 1997 El Niño event, the land biosphere was a remarkable carbon source and it changed to become a strong carbon sink after El Niño. We prepared an isotopic reference material of CO_2 and international inter-calibration was started for global integration of isotope data for atmospheric CO_2. Atmospheric and oceanic measurements utilizing ships-of-opportunity over the Pacific have continued, and we have precisely measured latitudinal distributions of atmospheric CO_2, CH_4, and N_2O. The accuracy of oceanic partial pressure measurement of CO_2 was improved with the installation of a newly developed CO_2 measurement system on board a cargo ship sailing between Tokyo and Seattle/Vancouver. We have continued monthly measurements of atmospheric CO_2, CH_4, and N_2O by aircraft at 3 locations in Siberia and 1 location over Sagami Bay. We observed the large influence of the terrestrial biosphere on the seasonality and vertical distribution of CO_2 and CH_4, and we analyzed the inter-annual variability in the terrestrial biosphere.

Global Warming Response Research Team

The Global Warming Response Research Team has been developing the Asian-Pacific Integrated Model (AIM) with Kyoto University and collaborating institutes in China, India, and Korea. The model includes AIM/local, AIM/top down, AIM/material, AIM/trend, and AIM/impact. The AIM family has been integrated to assess sustainable development policies that combine global emission control policies with regional and local policies, so that developing countries accrue real local benefits to human health and the environment as well as to economic development.

The AIM/local model is based on energy saving and pollution reduction technologies. We have used the AIM model to estimate the SO_2 reduction potential as one of the co-benefits of CO_2 emission reduction measures, and have also used the model to

analyze the potential for the implementation of the Clean Development Mechanism (CDM) in China. We have developed a global optimization model, which includes not only emission trading but also energy saving investment, for evaluating the economic benefits arising from energy saving investments under CO_2 emission constraints.

The research program has made major contributions to policy deliberations at the national, regional, and global levels. The AIM model has been used to provide global and regional emission scenarios and regional impact assessments for the IPCC. It has also been evaluated at the Stanford Energy Modeling Forum where it was compared against international emission scenarios and impact assessments. Other uses have included contributions to Eco Asia (the Congress of Asian Ministers for the Environment), the Global Environmental Outlook of UNEP, the UN Global Modeling Forum, and the Asian-Pacific Network Program.

Ozone Layer Research Team

Since December 2000, the Ozone Layer Research Team has been using the FTIR technique to observe inorganic halogen species, such as HCl, HF, and $ClONO_2$, over Tsukuba. This winter/spring season, on March 25 and 26, 2001, we measured the correlation between HCl and HF when a vortex filament passed over Tsukuba; however, we found no remarkable HCl depletion. This was in clear contrast to the observation at Rikubetsu in Hokkaido on April 15, 1996, when clear HCl depletion was observed. The contrast between the 2 observations was explained by the differences in the shape and scale of the polar air masses in 2001 and 1996. We also measured vertical profiles of ozone in Yakutsk and Salekard in Russia in the winter/spring season in 2001.

To examine if the activity of the Arctic polar vortex was enhanced we calculated Ertel's potential vorticities (PV) from 1958 to 2000 using the NCEP reanalysis data. We calculated the strength and size of the polar vortex using the equivalent latitude and averaged normalized PV gradient. From these analyses, we found a clear trend showing that the strength of the Arctic polar vortex is enhanced during periods of solar activity.

The Ozone Layer Research Team has been developing a 3-D Chemical Transport Model (CTM) to study chemical and dynamical processes in the stratosphere. This year, the model was applied to reproduce the distribution and variation of N_2O concentrations observed by the ILAS. Since N_2O is long-lived and its concentration in the air mass inside the polar vortex is lower than that outside, the model calculation made it possible to estimate the diffusion coefficient after a polar vortex breakdown. The model calculation shows that the concentration contrast remains clear for 1.5 to 2 months.

A chemical-radiative-dynamical coupled General Circulation Model (AGCM) has also been developed through joint research with the University of Tokyo. This year, the chemical reaction scheme of sulfur compounds was added into the model to investigate the effects of increased sulfuric acid aerosols due to volcanic activity on

stratospheric processes. The model calculation was able to simulate the variations in stratospheric ozone concentrations after the Mt. Pinatubo eruption.

The reaction of $ClONO_2$ with ozone was also studied in the gas phase. We found that the reaction could affect the NO/NO_2 ratio and result in a catalytic depletion of ozone. However, the observed rate coefficient was not large enough to induce additional ozone depletion in the lower stratosphere.

Acid Deposition Research Team

Acidic deposition is one of the most interdisciplinary environmental problems we are now facing. East Asia will soon be the largest source region for acidic pollutants in the world because of the increase in fossil fuel consumption accompanying rapid population growth and development of industrial activity. The Acid Deposition Research Team is conducting research into acidic pollution including: estimation of emissions, transport, deposition, impact on life/environment systems, and historical trends of pollution in East Asia, including China, Korea, and Japan.

Satellite Remote Sensing Research Team

The Satellite Remote Sensing Research Team has been taking a leading role in promoting the Improved Limb Atmospheric Spectrometer (ILAS) and ILAS-II projects for monitoring the stratospheric ozone layer from space. The ILAS instrument onboard the Advanced Earth Observing Satellite (ADEOS) was in operation from November 1996 until June 1997, when ADEOS lost its function due to solar battery failure. ILAS operated normally during those 8 months and gathered good data from both northern and southern hemispheres. ILAS-II, the successor of ILAS, will be launched in February 2002 and will have improved capabilities for characterizing stratospheric ozone layer chemistry and polar stratospheric clouds.

The team developed and has been modifying the ILAS data processing software. The revised software reflects the results of algorithm studies and instrument function evaluation conducted from 1996 through 2000. The ILAS data were processed to provide profiles of ozone and other minor gas species in the high latitude stratosphere. In 1997, ILAS measurements found significant ozone depletion in the Arctic region using a trajectory analysis technique. Appearances of PSCs were also identified from the ILAS data. This fact suggests that the ozone destruction mechanism causing the Antarctic ozone hole is occurring in the Arctic as well.

The team is also taking a leadership role in preparing an algorithm for ILAS-II data retrieval at the ILAS-II Data Handling Facility (ILAS-II DHF). Many lessons that we learned in ILAS data processing are of great help in this procedure. In addition, we have started studies on data retrieval of the Solar-Occultation FTS for Inclined-orbit Satellite (SOFIS), which is a next generation satellite sensor developed by the Ministry of the Environment of Japan. Since SOFIS will introduce a Fourier-Transform Spectrometer (FTS) instead of a grating spectrometer like those that were used in ILAS and ILAS-II, we need to develop a new type of algorithm for SOFIS data retrieval. The SOFIS is scheduled to be launched in 2007.

Marine Environment Research Team

Most human impacts on the environment ultimately appear in the marine system causing multiple and diverse problems. Among these problems, the Marine Environment Research Team is dealing with issues such as: 1) the tendency toward a deficiency of silicon relative to nitrogen or phosphorus in coastal seas and the consequent change in the marine ecosystem, from one rich in diatom species to one rich in non-diatom species, caused by the alteration of land-based discharge of these elements; 2) pollution of seawater by hazardous chemicals; and 3) deterioration of coral reefs. These problems are becoming significant in Asian marginal seas. To assess the tendency toward a deficiency of silicon, we are developing an integrated monitoring method using ships-of-opportunity (i.e., a container ship sailing between Japan and ASEAN countries to cover the Asian marginal seas and a ferry in the Seto Inland Sea) to obtain a high temporal/spatial resolution of the changes in biogeochemical parameters. To monitor pollution of seawater by hazardous chemicals, an oil tanker plying the wider area ranging from the Pacific to the Indian Oceans was used. To detect deterioration of coral reefs, we are making a long-term archive of underwater stereo images of coral reefs to record and analyze the growth, deterioration (such as the bleaching phenomena), and sustainment of the biodiversity.

Natural Vegetation Conservation Research Team

In order to clarify the ecological service value of tropical rainforests, the Natural Vegetation Research Team studied: 1) impacts of logging on forest structure; 2) carbon sequestration potentials of primary forest, logged forest, and agricultural land; 3) maintenance mechanisms of biodiversity in lowland rainforest; and 4) the socio-economic value of tropical rainforest in Peninsular Malaysia. We also studied changes in land use in the vicinity of the Pasoh Forest Reserve, Malaysia, where the above-mentioned studies were conducted. To investigate the impacts of logging and the recovery process of vegetation after selective logging, we established a 12-ha plot near the Pasoh Forest Reserve and carried out a tree census. We measured tree density and total basal area, and identified and mapped trees injured by logging operations. To estimate carbon sequestration and release from the forest, we employed a compartment model that quantifies the carbon flow and the flux. To construct this model, we studied the spatial and temporal variations in soil respiration rates and litter decomposition rates in the primary and logged forests and in an oil palm plantation, and examined the environmental factors that affected these properties. In addition, we used aerial photography to estimate and compare total above ground biomass (TAGB) in the primary and logged forests. To understand the heterogeneity of rainforest microenvironments, which are known to be important factors in maintaining the high species diversity by sustaining the great variety of spatial niches, we measured the photosynthetic responses of 3 understory tree species in their natural light environments. The ratio of total daily photosynthetic carbon gain under fluctuating natural light to that under simulated constant light with the same total light energy varied with microsite, species, and light fluctuation pattern. In addition to this study, we examined effects of spatial and seasonal changes in microenvironments on leaf demography in 5 naturally occurring dipterocarp seedlings. To study the socio-economic value of the tropical forest, we conducted conjoint analysis in 4 major cities in Malaysia to determine public opinion as to the best balance of land use. To establish a risk management program against changes in land cover, to which most of

the output of the ongoing research can be integrated, we collected geographical, socio-economical, and vegetation information about the study area. As part of this study, we used satellite images and land cover information to study land use changes.

Wildlife Conservation Research Team

Wild species exploit resources essential to their lives. These resources are distributed according to their own rules and form the habitats of wild species. Human utilization of these habitats significantly influences the survival and extinction of wild species. One of the topics the Wildlife Conservation Research Team studies is the impact of temporal/spatial alteration of habitats on biodiversity. Human utilization of wild species in industrial perspectives also affects biodiversity. Another such topic is the impact of biological invasion on biodiversity.

In studying these topics, we employed a system to quantitatively evaluate habitat distribution on a geographical scale. We classified vegetation cover in 2 river systems of the Kanto Plain according to habitat specificity for wild species and recorded this information on a geographical information system database. These data enabled us to assess the habitat suitability of the area at arbitrary regional scales.

In addition, we performed genetic analyses of the distributions of wild species. We surveyed the gene frequencies within the species' distribution range based on sequences or fragment lengths of genes on mitochondria and nuclear genomes. These genetic data revealed that wild species possess a certain degree of genetic variation within their geographical ranges. For migratory species, gene flow could also be estimated between local populations. As for biological invasion, artificial selection and propagation of individuals from certain local populations was revealed to be a threat to the geographical biodiversity.

HDP (Human Dimensions of Global Environmental Change Program) Team

In light of the increasing importance of the human dimension in global environmental issues, the HDP Team started in FY 1995 as a reorganization of the Global Environment Research Program researchers whose interests were related to the International Human Dimensions of Global Environmental Change Program (IHDP). The interests of this team cover: 1) the effects of land use/cover change on global environmental change (Land Use for Global Environmental Conservation: LU/GEC); 2) international comparison of public perception, knowledge, behavior, and communication towards the environment; 3) human activity and its impacts on the environment and socio-economic system; 4) global environmental risk assessment; and 5) other HDP related issues.

Emission and Deposition of Gaseous and Particulate Pollutants

We collected precipitation and gaseous and particulate pollutants at Happo-one (altitude 1850 m) in the Japanese Alps and elucidated the processes by which precipitation captures gaseous and particulate pollutants from the atmosphere. We obtained 4 washout coefficients for sulfate (Wc; s^{-1}); by combining these with data of the previous year, we obtained the relationship $Wc = 1.86 \times 10^{-5}P^{1.70}$ between Wc and rain intensity (P; mmh^{-1}). We measured air pollutants (HCl, HNO_3, SO_2, and NH_3) on the coast of the Sea of Japan (a low pollution area) and in Kobe city (an

urban area) with a 4-stage filter holder method. The concentrations of almost all gaseous pollutants were higher in Kobe city than on the coast of the Sea of Japan; however, in the case of NH_3, the difference was small.

We compiled detailed emission inventories of air pollutants in east Asia, with a priority on Chinese emissions. Gridded emission fluxes of SO_2 and NO_x were compiled with 60 emission source categories and 20 fuel types. National annual emission amounts of SO_2 and NO_x were 22.8 Tg-SO_2y^{-1} (21.0 in 1990) and 9.64 Tg-NO_2y^{-1} (6.72 in 1990), respectively. To compile the gridded emission amounts of biogenic, non-methane volatile organic compounds, we evaluated the seasonal variation as well as geographical distribution by sensitivity analysis of emissions with vegetation data.

To generate an emission-deposition matrix of air pollutants among east Asian countries, we have started to develop a long term evaluation model. Combining the regional meteorological model (CSU-RAMS) and chemical transport model (STEM) into a single model, episodic air pollution can be simulated and the model simulation can elucidate the distribution of air pollutants, such as sulfur dioxide and sulfate in East Asia. Kosa, which is the most important neutralizer for acidic species in the atmosphere, is introduced in another model to predict the acidity of precipitation. A numerical soil particle emission module was established to predict the emission of Kosa into the atmosphere. Regarding the neutralization of precipitation with Kosa, the pH of precipitation increased by 0.6-1.8 in the northern part of China, there was no effect on precipitation pH in the southern part of China, and the pH of precipitation increased by 0.1-0.2 in Korea and in Japan.

Behavior of the Atmospheric Pollutants in a Forest Area

To investigate the behavior of atmospheric pollutants in a forest area, we carried out field observations in a red pine forest in Oshiba Kogen, Nagano Prefecture. From a 22-m tower, we measured ozone flux over the canopy with the heat balance/Bowen ratio method. We observed upward ozone fluxes within the space a few meters above the upper edge of the canopy, suggesting that photochemical ozone formation was taking place in a rather thin layer immediately above the leaf layer. On the other hand, the vertical distribution of ozone concentration within the canopy showed characteristic features: the distribution had a maximum at a height of about 5 m from the ground and a deep minimum in the leaf layer. The minimum clearly indicated that the leaves of red pine trees contributed to some ozone removal process, although it was not clear whether such removal was due to direct deposition to leaves or to a chemical reaction with gases, such as terpenes, emitted from the leaves. Note that the maximum concentration within the canopy was higher than the concentration above the canopy. This suggested that ozone formation was also occurring in the canopy. There was an inversion in the vertical temperature distribution measured at the same time; this seemed to hinder air exchange between the inside and outside of the canopy and facilitate the photochemical reaction below the leaf layer. By collecting particles with a low-pressure Andersen Impactor, we observed that the size distribution of ammonium sulfate particles had a peak around 0.5 μm; this was consistent with an inference that peroxides were produced through the reaction of ozone with terpenes.

By chance, in the observation at the end of August, we observed an unusually high concentration of sulfur dioxide; this was undoubtedly caused by the volcanic activity on Miyake Island.

The Decline of *Betula ermanii* and *Abies veitchii*

To clarify the relationship between environmental factors and the decline of *Betula ermanii* and *Abies veitchii*, we examined the growths (height, diameter at breast height, stem volume, and stand density) of *B. ermanii* and *A. veitchii*, ozone concentrations, and the soil conditions on the northwest (where the species were not in decline) and southeast (where the species were in decline) upper slopes of Mt. Mae-shirane. There was a remarkable difference between *B. ermanii* growth on the 2 slopes that was in accordance with our evaluation of its level of decline (4 levels); the heights and diameters were significantly greater on the northwest slope than on the southeast slope. The diameter correlated with the height on the northwest slope, but not on the southeast slope. Because the contents of leaf Rubisco and chlorophyll were much lower on the southeast, the photosynthetic rate might be decreased. We did not observe any lack of nutrient elements or excesses of Al and Mn in leaves or soil, so the decline of *B. ermanii* cannot be explained by soil fertility.

Further, we conducted O_3 exposure and water stress experiments. The dry weights of leaves, stems, and roots of plants exposed to O_3 were significantly lower than the control values. In the water stress experiments, dry weights of leaves and stems were significantly lower than the control values. Dry weights of leaves and stems were significantly decreased by the combined ozone-water stress treatment. Exposure to 100 ppb O_3 caused significant reduction of RGR, but we did not observe any significant differences in RGR in the water stress or ozone-water stress treatments. Clearly, a high concentration of ozone is a possible factor in the decline of *B. erminii*.

We have utilized the acid deposition monitoring network to conduct studies and investigations on the effect of acid rain on ecosystems in the Philippines, Thailand, Malaysia, and Vietnam.

Aerosol Elements on Tree Leaves

To investigate the impacts of aerosols on trees, we collected more than 300 samples of tree leaves (mainly *Cryptomeria japonica*) from urban, suburban, and rural areas in Japan. Aerosols deposited on the leaves (leaf aerosols) were isolated and analyzed by instrumental neutron activation analysis. The amounts of elements in leaf aerosols (aerosol elements) increased with leaf age to reach a steady maximum on 1-year-old leaves. Amounts were greater on conifers, especially on *C. japonica*, than on broad-leaved trees, and usually greater on upper leaves. The aerosol elements had various origins: the non-terrigenous component included more than 90% of the Au, Ag, and Sb contents of the total aerosol; about 80% of the Zn and Cr; about 70% of Cl; 30%-50% of As, I, Se, and Br; and 10%-30% of Co, V, and Fe. On the other hand, Th, Hf, Rb, Ta, Ti, Mn, Al, and rare earth elements originated mostly from soils. Sb, originating mainly from vehicle exhausts, was highly concentrated in leaf aerosols (enrichment factor *vs*. soil: 2.2-150; av. 38), and its amount correlated with NO_x concentration

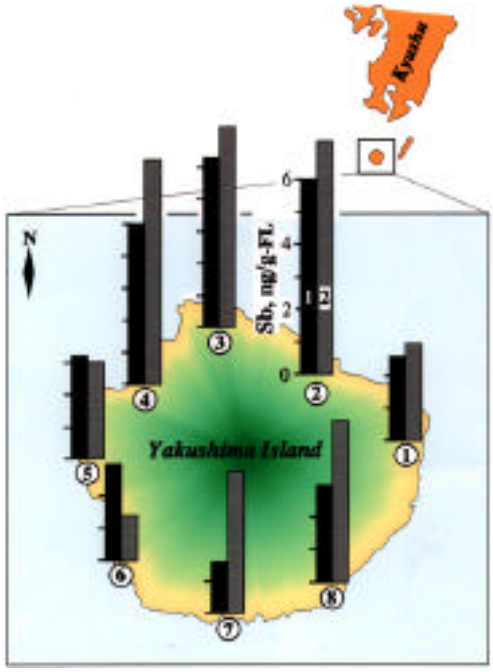


Fig. 1
Amounts of aerosol-Sb on *Cryptomeria japonica* leaves from 8 sites around the coast of Yakushima Island.
(1) 0-year-old leaves,
(2) 1-year-old leaves.

and population density in each sampling area. The distribution of *C. japonica* (and also *Pinus densiflora*) everywhere throughout Japan, makes aerosol-Sb on their leaves a good indicator for monitoring air pollution due to daily human activity. Amounts of aerosol-Sb on *C. japonica* leaves from 8 sites around the coast of Yakushima Island (Fig. 1) were clearly higher on the north side of the island than on the south (average for sites 2-4: 6.1 ± 0.9 ng/g-FL; average for sites 6-8: 3.1 ± 1.4 ng/g-FL; $P < 0.01$), suggesting transport of pollutants from Kyushu (and to a lesser extent from east Asia).

Techniques for Controlling Emission of Acid-Precursors

Practical and effective techniques for controlling SO_2 and NO_x emissions from coal combustion in east Asia are urgently needed. In addition, it is necessary to evaluate the effects of applying emission-control techniques on indoor and urban atmosphere, materials, plants, as well as on human health. According to these considerations, we carried out the following studies.

(1) To utilize low-grade coals of high sulfur content and to control pollutant emissions in China, we developed a coal-biomass briquette technique and a new electrostatic dry coal-cleaning technique, which can be used to separate the coal from pyrite, ash, and various other minerals. Coal-biomass briquettes were shown to have a high desulfurizing efficiency, low ignition temperature, and higher combustion efficiency than conventional coal briquettes. We investigated factors for propagating the bio-briquette technique with a view to the construction of new factories in the future. We found that the coal-biomass briquette technique (Fig. 2) and the electrostatic dry cleaning-coal technique are simple, economical, and efficient. Bio-briquettes are applicable for controlling air pollution from coal combustion, not only in China but also in many developing countries.

(2) We investigated the characteristics of the bio-briquettes. The experimental results showed: (a) combustion of 1 kg biomass emitted 35–912 mg HCl and 52–1764 mg SO_2; (b) the breaking strength of the bio-briquettes increased with increased amount

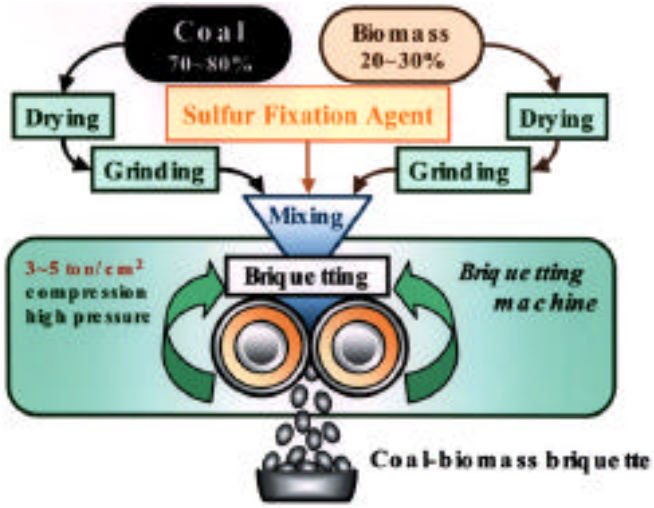


Fig. 2
Production flowchart of the coal-biomass briquette.

of added biomass as well as with the lignin content of biomass. The best results were achieved by adding 25% biomass; (c) compared to coal, HCl emissions were reduced by 26%–61%, SO_2 was reduced by 82%–88%, and dust was reduced by 55%–83%; (d) residual ash from bio-briquette combustion can be used as a neutralizer of acidic soil and as a fertilizer for crops.

(3) We qualitatively and quantitatively monitored acid depositions over a long period by utilizing the surface corrosion rates of various materials. We characterized the type of corrosion on steel, copper, and marble pieces by the type and concentration of air pollutants. Among the air pollutants, SO_2 was significantly corrosive to metallic and marble materials. (Many cultural and/or historical artifacts are made of marble). Cuprite (Cu_2O) and tenorite (CuO) formed on the copper plates under the combination of an immersion test and a programmed cyclic corrosion test. This new technique, i.e., the combination of the gas corrosion test and the programmed cyclic corrosion test, can be used to simulate actual environmental conditions.

Detecting Anthropogenic Changes in Marine Ecosystems

Environmental stresses to the sea, such as the discharges of manmade hazardous chemicals, organic matter, and nutrients, cause deterioration of marine ecosystems and ultimately affect human health. At the same time, marine environmental issues involve far more uncertainty than their terrestrial counterparts and contain the fundamental question of how the ocean, particularly the function of its ecosystems, plays a positive role in stabilizing the earth's environment. The Marine Environment Research Team has carried out the following projects with the 2 main objectives of detecting how marine systems change in response to environmental stresses and reducing the inherent uncertainties in examining environmental issues.

To sample and detect hazardous chemicals in seawater on a global scale, we developed a monitoring system suitable for deploying on merchant ships. The monitoring system is composed of 3 units: the seawater sampling and storage unit, the hazardous chemical continuous-extraction unit, and the control unit that includes a sensor to continuously monitor seawater quality. Figure 3 shows the monitoring system mounted on a tanker, which is sailing between Japan and the Persian Gulf.

Fig. 3
Persistent Organic Pollutants monitoring system deployed on a tanker.

Since 1996, before this program, we have been operating a similar system deployed on a ferry in the Seto Inland Sea, a typical semi-enclosed sea. In addition, hazardous chemicals in the marine atmosphere have been monitored from the same ferry since 1997. These results showed that the origin of β-HCH in seawater mostly comes from the re-suspension of β-HCH accumulated in the sediment, and partly from influx from rivers. α-HCH, γ-HCH, chlordane, and nonachlor mainly come from atmospheric depositions and partly from riverine influx and precipitation.

Concerning biogeochemical factors, a new marine environmental issue has been recognized internationally based on the “silica deficiency hypothesis”; that is, anthropogenic impacts tend to increase the discharge of N and P and decrease the natural supply of Si. The combined effect of these may cause unfavorable conditions for diatoms, which require silicate. This tendency will further lead to a shift from a marine ecosystem based on diatom species to one based on non-diatom phytoplankton species that sometimes cause nuisance states such as red tides or other harmful algal blooms. In order to detect this tendency, we monitored DIN (dissolved inorganic nitrogen), DIP (dissolved inorganic phosphorus), and DSi (dissolved silicate), as well as the compositions of the taxonomic groups of phytoplankton. We carried out this monitoring from a container ship sailing the following track: Japan–East China Sea–South China Sea–Malacca Strait–Malaysia. The seasonal changes in DIN, DIP and DSi normalized by the element ratio of averaged phytoplankton (Redfield ratio) 16 : 1 : 32 at 6 points from May 2000 to February 2001 are shown in Figure 4. At the

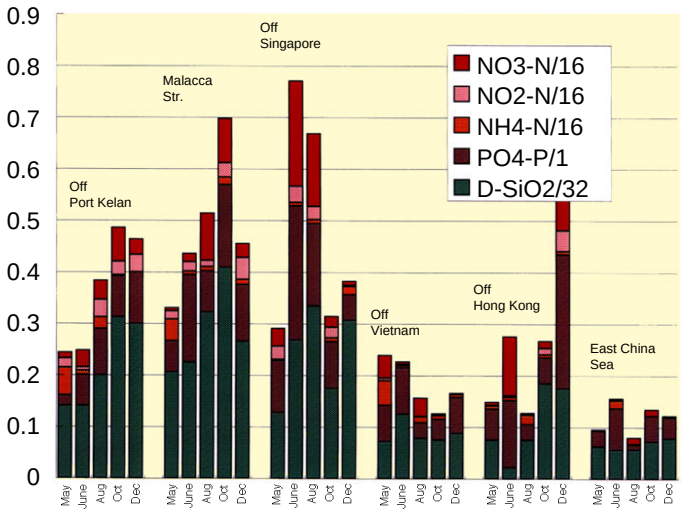


Fig. 4
Seasonal changes in DIN, DIP and DSi monitored at 6 points along the track of the container ship ACX-LILY (Tokyo Senpaku Co., Ltd.) from May 2000 to February 2001. The values are normalized by the element ratio of averaged phytoplankton (Redfield ratio) 16 : 1 : 32.

points off Hong Kong, the values of DSi were lower than the values of DIN or DIP, and dinoflagellates and other non-diatom species appeared after a thick diatom bloom. These results show a tendency toward silica deficiency. On the other hand, the East China Sea and South China Sea are basically oligotrophic and DIN is remarkably depleted. Nitrogen-fixing cyanobacteria and pico-cyanobacteria appeared in these seas. In the Malacca Strait, DSi is abundant, showing its rapid recovery in the surface layer due to the shallowness of the strait.

To promote international cooperation with this monitoring, an international meeting toward Cooperative Environmental Monitoring in the Asian Marginal Seas (CoMEMAMS Meeting) was held twice in Tokyo (1998 and 2000) inviting researchers from China, Korea, Malaysia, the Philippines, Singapore, and Vietnam. The conclusion of the meetings is that the above monitoring program should be carried out on the basis of decisions reached by the participants of the "CoMEMAMS Panel".

Conservation of the biodiversity in coral reefs, which have been called "the tropical rainforests of the sea", is globally recognized as an urgent issue. Corals are unique organisms in that the 3-dimensional structure constructed by the growth of their colonies generates secondary habitats allowing the sustainment of biodiversity. To analyze this mechanism, we developed a method of archiving underwater stereo images and applied it to the reef in the Yaeyama Islands, Okinawa, Japan. A sample image (Fig. 5) shows that coral colonies tend to be recruited and grow on the projections rather than on the hollows; this avoids siltation and efficiently lets symbiotic algae attain light for photosynthesis.

International Comparative Study on Asian Consumers and its Transition

The aim of this project is to use public opinion studies to investigate the attitudes and behaviors of Asian consumers and industries towards the environment. This fiscal year, we surveyed 1) environmentally active Japanese companies about their environmental communication strategies, and 2) Chinese consumers in Hubei Province. Of the 685 Japanese companies that responded to our survey on environmental

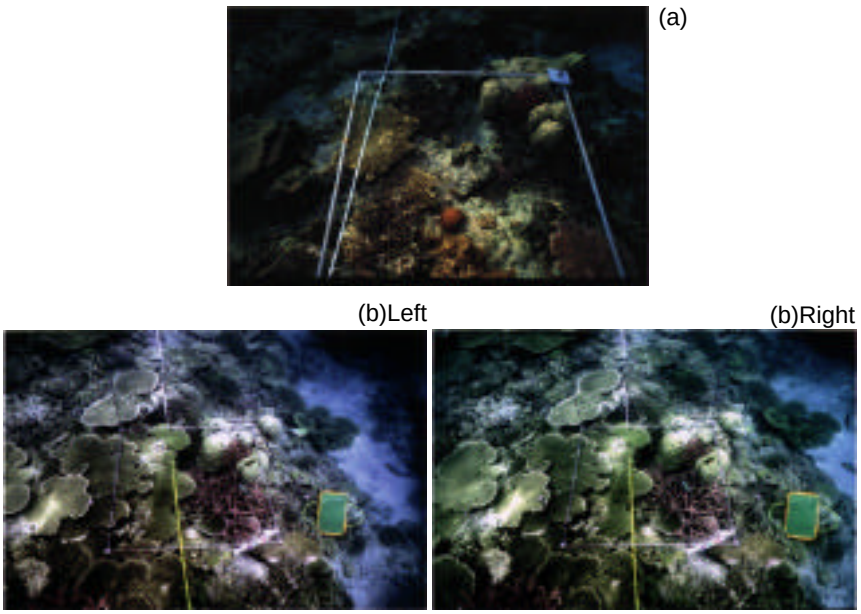


Fig. 5
Selected images of coral colonies from the Underwater Image Archive processed from photos taken yearly at a permanent quadrat/ transect at the Yaeyama Islands, Okinawa. Plates (a) and (b) were taken in 1994 and 2000, respectively. The latter is a stereo pair. The unoccupied space found in 1994, which was caused by damage by the crown-of-thorns starfish, had recovered by 2000 due to recruitment and growth of the coral colonies.

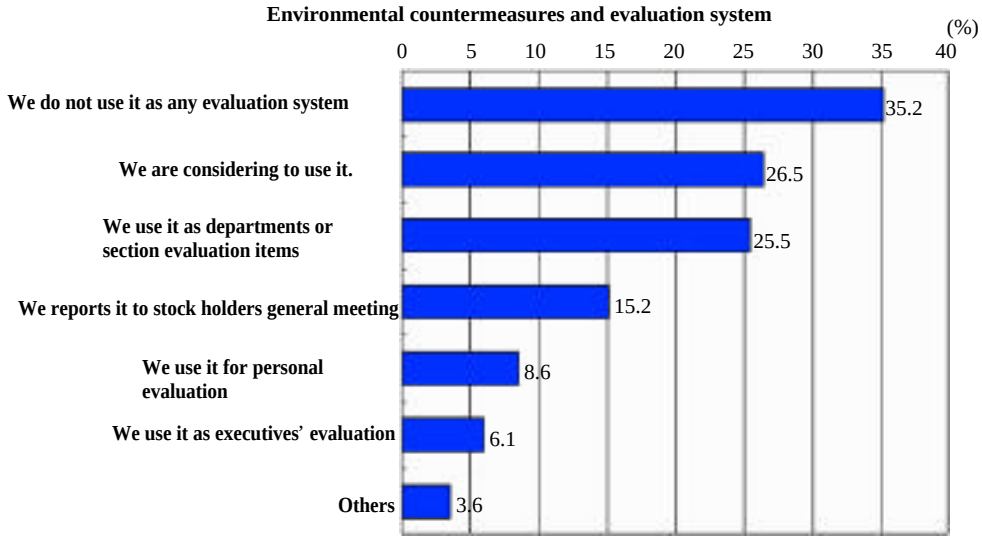


Fig. 6
Attitudes of companies to a system to evaluate environmental countermeasures.

communication strategies, 475 had published or are planning to publish environmental reports.

Major findings were that: a) for about 30% of responding companies, environmental countermeasures were a major factor when evaluating their personnel and sections (see Figure 6 & Figure 7); b) the most important means for disseminating environmental information were through "Environmental Reports" and "Internet Websites". The environmental reports of more than 70% of the companies appear on internet websites; and c) 37% of responding companies answered that they had changed their environment related strategies because of requests from consumers and other stakeholders.

A Study on the Process of Transformation Towards an Industrial Society with Least Environmental Burden

The purpose of this study was to evaluate the possibilities of voluntary environmental management including ISO14001, LCA, and other related techniques of industrial transformation. The study consisted of 3 major investigations: a survey on the present state of environmental management systems introduced in companies and local governments, an analysis of the effects of environmental management systems on environmental burden reduction, and research into obstacles that need to be removed. These are expected to result in development of supporting countermeasures for

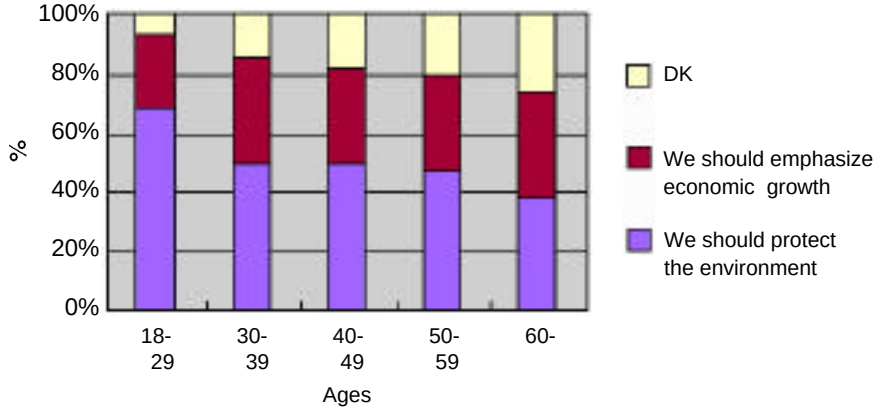


Fig. 7
Consciousness of company personnel to the environment and economy.

effective voluntary environmental management systems.

Using a questionnaire, we investigated the effects of ISO14001 on the environmental burden control in various enterprises. There is growing interest from enterprises in applying environmental management systems such as ISO14001 to decrease environmental burdens. However, although most of the enterprises surveyed made new policies and organizations to apply ISO14001, they did not sufficiently change their actions concerned with environment. A few enterprises carried out PRTR and LCA. The management of profit tended to limit investment in strategies to conserve the environment. In many enterprises, information associated with environmental management systems is not publicly available. ISO14001 was positively correlated with environmental actions, but negatively correlated with environmental burden control and advanced systems. The advanced systems were positively correlated with environmental burden control. We found that disclosure of the environmental conservation costs and disclosure of internal audit results both correlated positively with the advanced systems. Thus, so far ISO14001 at a policy level has not yet changed the environmental burden control at a practice level. It seems possible that disclosure of environmental conservation costs and internal audit results could advance environmental burden control.

Study of the Processes and Impacts of Land-Use Change in China

1) Potential productivities and possible increase of crop production in northern and northeastern parts of China

The northern and northeastern parts of China are 2 of the largest bases for crop production in China. It is very important to evaluate potential productivities and possible increases of crop production in these areas from the viewpoint of food self-sufficiency. Therefore, we first developed a set of digital maps including base maps, socioeconomic maps, meteorological maps, soil maps, and land use/land cover maps at a scale of 1:1,000,000. Then, we produced another set of maps showing potential crop productivities under different limiting factors and the increases of production possible for each crop by improving those limiting factors.

2) Environmental degradation in northern China due to land-use change

We studied the long-term problem of declining groundwater resources due to changes in land use and water use in the Hebei plain, northern China. We constructed a quasi 3-dimensional model of groundwater flow to simulate long-term changes up to 2030 in the groundwater level and the head of the unconfined/confined aquifers in the Hebei plain for several given groundwater pumping scenarios. The simulation shows that continuous pumping of groundwater at the 1994 rate may inflict serious damage on the unconfined aquifer in the vicinity of big cities located in the western region, as well as on the confined aquifer in the eastern region by 2030 (Fig. 8). On the other hand, pumping of a proper amount of unconfined groundwater is expected to be effective for the prevention of soil salinization.

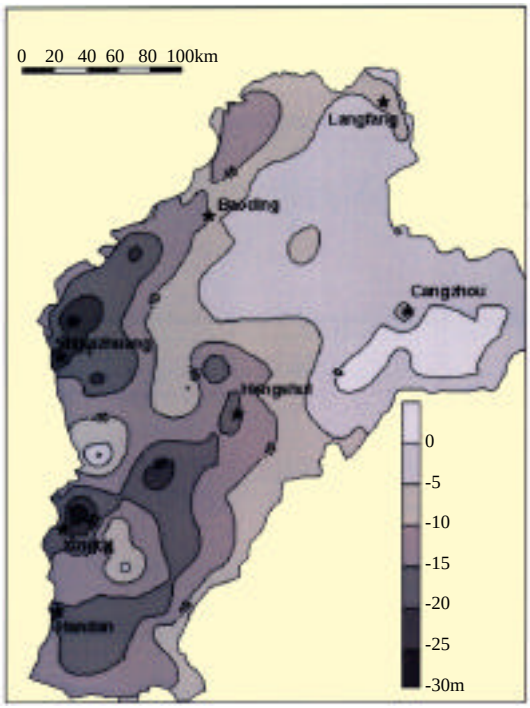


Fig. 8
Simulated result of the drop from the 2000 groundwater level in the unconfined aquifer at 2030 (Scenario: Continuous pumping of groundwater at the 1994 rate) .

Studies on Communication and Countermeasure-Making Procedures Concerning Global Environment Risk Management

We conducted a 3-year research program on risk management of the global environment; the 2 most contrasting sub themes–those concerning climate change and acid rain–were successfully carried out in the second year.

1) On the basis of the environmental security concept, we examined the standpoint of our nation on climate change issues by reviewing various expected incidents, constructing the notions of the environmental security concept, and describing the historical development of the concept of the comprehensive security of Japan. To develop an instrument for national level policy-making, we closely examined the opinions and actions of citizen's panels in 3 autonomous bodies on the basis of our risk management formula to reveal ways to recognize and cope with the climate change risk. As a concrete measure of how local residents cope with the climate change issue, we surveyed and evaluated the development processes of wind power generation. Finally, we took into account the social constructivism approach in science studies to deal with the processes of opinion making under the limitations of uncertain scientific knowledge. The approach unveiled 3 stages in the life of scientific knowledge–production, distribution, and consumption. Each of these stages has an implication in the way a non-expert forms an opinion concerning a science-related issue.

2) We investigated the history of international cooperation to overcome the acid rain problems in east Asia, as well as in Europe and North America. The study showed that long-term cooperative research and intensive negotiation in addition to activities by various NGOs have been, and will continue to be, essential to reach an agreed SO_2 protocol. The study proposed a prototype of an international regime to prevent acid rain damage in the region. Further, we scrutinized policies of economic development and environmental regulation in China to predict the acid rain status in the near future and the possibility of international cooperation in Asia. Environmental degradation

due to acid rain caused by coal combustion has been observed in south China. Our study points out the fact that the Chinese government has recently strengthened emission regulations; this is considered the consequence of diplomatic awareness of the risk recognition by their neighboring countries.

Plans to Maintain Global Environmental Protection from Widely Arsenic-Affected Groundwater

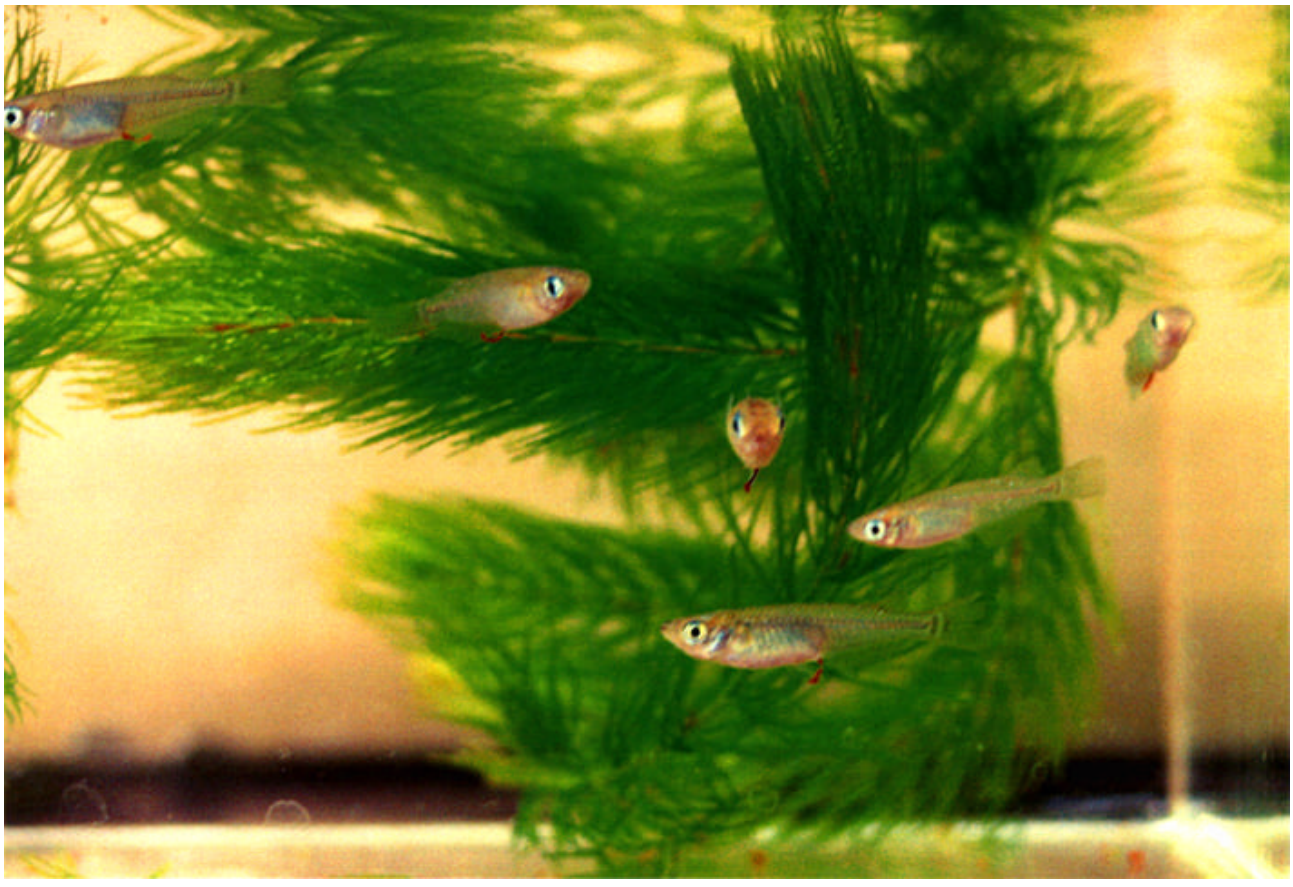
We plan to study the environmental cycling of arsenic in groundwater, especially after its use, in an arsenic-polluted area of West Bengal, India, in order to establish a scientific basis for the mitigation or remediation of the pollution.

The toxicity and environmental cycling of arsenic depends on its chemical form. Because Cl^- in environmental samples interferes with the speciation of some of the arsenic compounds by producing a $^{75}(ArCl)^+$-pseudo-peak in HPLC-ICP/MS, we developed an alternative speciation method based on the combination of HPLC, ultrasonic nebulizer, and microwave-induced plasma (MIP)/MS (HPLC-UN-MIP/MS); this was found sufficiently accurate to be applicable to analysis of real samples, including human urine. We collected several environmental samples, including atmospheric particulate matter, from the Domkal region, West Bengal, and arsenic analyses of them are now in progress.

Interdisciplinary Study on the Environmental Management, Planning, and Risk Communication in Gold Rush Regions

Problems arising from small-scale mining can be classified into different facets; e.g., environmental, technological, economic, cultural, and social. This research was initiated in April 2000 to coordinate many different methodologies toward a comprehensive solution. Environmental factors in areas of small-scale gold mining include denudation of forests, siltation of streams, pollution of water, soil and air, and poisoning of residents by mercury compounds formed during smelting and refining. Many of the problems in this category are directly or indirectly related to the behavior of mercury on the surface of the earth. Because knowledge of the basic analytical chemistry will contribute greatly to anticipating environmental change and damage to life, the project includes a basic study on the geochemical behavior of mercury. This basic study will review and develop analytical techniques and carry out chemical analysis of samples. During the first fiscal year, we reviewed the basic mineralogy and geology, and observed the mining and smelting practices in the Philippines. We obtained geologic materials and artifacts from a number of areas and analyzed them to determine the mercury concentration. In addition to these analyses, we applied the PIXE method to water and human hair samples. Many hair samples have already been analyzed and the donors informed of the results through our onsite project partners. The state-of-the-art PIXE of application in this project has been summarized and published, and forms the basis of an improved analytical system.

Regional Environment Division



The Regional Environment Division is a research unit dealing with both national environmental issues and overseas environmental pollution problems. The unit is composed of 16 research teams and 3 principal research staff. Team members have worked in cooperation with members of other NIES divisions and visiting scientists from both domestic and overseas institutions. Major target areas include environmental risk assessment, and pollution mechanisms and countermeasures. Since 1993, international research teams of the Division have been actively promoting the transfer of environmental technology to developing countries. Following is a summary of the current studies of the respective teams. Not all the Division's research projects are included in the present report. Research reports from the respective teams have also been published separately and are available upon request.

Traffic Pollution Control Research Team

This team mainly studies 1) methodologies for assessing the environmental impacts of traffic systems, particularly motor vehicles, and 2) technology assessment of environmentally advanced transport systems.

In recent years, monitoring and regulation of a number of volatile organic compounds (VOCs) in the air have been initiated because of their detrimental effects on health. We have carried out studies to estimate VOC emissions from motor vehicles and fuel distribution systems. We developed a model/calculation system of 1 × 1 km resolution based on a geographical information system (GIS). The system consists of the following: 1) road traffic census data matched to a digital road map, 2) detailed traffic composition data estimated from existing statistics, 3) VOC emission factors based on chassis-dynamometer studies and tunnel studies, 4) geographical position data of over 50 000 gasoline stations, 5) data on composition and distribution of gasoline, and 6) 1 × 1 km-resolution meteorological data based on data from AMEDAS.

We have tested an automatic multi-VOC monitoring system, which uses a GC/MS equipped with automatic data handling software for analytical quality assurance (AQA), by long-term monitoring of over 30 VOCs. Data from the automatic system agrees well with those measured by the official manual monitoring methods.

To accurately evaluate vehicle performance and exhaust characteristics, we designed and constructed an innovative vehicle test facility. In addition to conventional test instruments, it also has a 2-axis chassis-dynamometer, a temperature and humidity controllable wind-tunnel-type test room, a high-ratio dilution tunnel, and a large-volume diffusion chamber.

Accurate information on car use–for example, detailed patterns of driving style and journeys taken–and other conditions, such as temperature and road gradient, are indispensable not only to design and discuss an efficient and acceptable alternative to the present transportation system, but also to elucidate the characteristics of air pollution from vehicle exhausts. We have developed a monitoring system to collect such information, and have carried out a preliminary survey.

Traffic demand management (TDM) is an important and fundamental policy to reduce traffic pollution and energy consumption by traffic. We found that urban structure and life pattern affect car-use and, consequently, affects energy consumed by transportation. We reviewed and compared the present Japanese situation with urban planning policies designed to reduce car-dependence and to promote trips by foot, bicycle, and public transportation.

Urban Air Quality Research Team

The major objectives of the Urban Air Quality Research Team are to investigate the mechanisms of urban air pollution formation in order to understand the relationship between changes in the relative importance of various air pollution sources and the spatial and temporal patterns of urban air pollution. The team's program for FY 1998 to 2000 comprised 5 research activities, mainly focused on characterizing sources of VOC.

In cooperation with the Traffic Pollution Control Research Team, we continued a survey of VOC emissions from mobile and fixed sources based on inventory analysis. We used tunnel data to evaluate VOC emission factors from mobile sources in a real world situation. We updated our emission database for solvent VOC from painting and printing.

Analysis of air pollution trends related to changes in pollution loadings from various sources suggested a change over time in the mechanism of photochemical ozone formation in summer in both the Kanto and Kansai areas. Recently, we observed regional photochemical ozone maxima outside the central Kanto and Kansai areas. This trend of the maximum concentrations of urban oxidants spreading might be a reflection of increasing NO_x emissions–indicating an increase in ozone formation potential–and a decreasing ratio of the concentrations of VOC to NO_x–indicating a decrease in photochemical reactivity. In FY 2000, we conducted a series of 3-dimensional field observations covering the Kanto and Kansai areas to determine the mechanisms of air pollution formation.

We conducted thermally stratified wind tunnel studies, mainly focusing on air pollutant distribution in street canyons, to understand the dynamic behavior of urban air pollution. From the wind tunnel data, we developed a practical model for predicting air pollution concentrations for different degrees of atmospheric stability and different street dimensions. The results are useful for determining the optimum sites for air pollution monitoring stations, particularly for investigating the concentrations of hazardous VOC from automobiles. In FY 2000, we continued a study comparing wind tunnel data and computer-simulation data, in cooperation with the Japan Clean Air Program.

Analysis of air pollution trends has shown that annual average concentrations of ozone are increasing over a wide area of Japan. To determine the reasons for this increase, we continued our study applying the Models-3/Community Multiscale Air Quality (CMAQ) modeling system in association with the US EPA/National Exposure Research Laboratory.

Coastal Environment Research Team

The Coastal Environment Research Team aims to develop a precise scientific method to evaluate the vulnerability of shallow ecosystems through a special research project entitled “Studies on the Effect of Restorations on Marine Ecosystems and Restoration Efficiency in Coastal Zones”.

As a part of the project, we conducted field surveys in Sanban-se, a shallow area at the head of Tokyo Bay, monitoring water quality, phytoplankton, and macro- and meiobenthos. Bivalves were the dominant benthos, accounting for more than 98% of the total biomass in terms of flesh dry weight (DW). Bivalve filter feeders can clear water columns and affect material cycles in shallow areas. We examined clearance or filtration by bivalves in laboratory and *in situ* experiments. We measured the clearance rates of the Manila clam *Ruditapes philippinarum* for chlorophyll-*a* (Chl-*a*) and various potential prey items (bacteria/picocyanobacteria to chain-forming diatoms) at 24˚C in the laboratory. The soft-body-dry-weight (DW)-specific clearance rates for Chl-*a* were generally greater than 1.5 $dm^3 g\text{-}DW^{-1} h^{-1}$ (average = 2.0 $dm^3 g\text{-}DW^{-1} h^{-1}$) and were comparable to those for other bivalve species. Picocyanobacteria (ca. 1 µm long) and prey items larger than 2 µm were also filtered effectively. However, the specific clearance rates for free-living bacteria (ca. 0.4 µm long) were much lower than for other prey items (Fig. 1).

We measured sediment oxygen consumption (SOC) at a muddy sediment site (21 m in depth) in the Seto Inland Sea, Japan, once every 3 d in summer 2000. During the experimental period (15 July to 9 August), a diatom bloom occurred, lasted for about a week, and then ceased. The vertical flux of organic carbon and Chl-*a* at 12.5 m depth peaked sharply after the development of the bloom. Under these conditions, SOC ranged from 1.4 to 3.0 mmol-O_2 m^{-2} h^{-1} and was greatly affected by the biomass of macrozoobenthos present in the experimental chambers used for SOC measurements. However, SOC did not follow the changes in the vertical fluxes of organic carbon or Chl-*a*, and the effects of other factors, such as water temperature, concentrations of sediment Chl-*a*, and bacterial abundance, were minor. When SOC values corrected for macrozoobenthos biomass (1.8 mmol-O_2 m^{-2} h^{-1}) were converted into the decomposition rates of organic materials they were nearly balanced with the

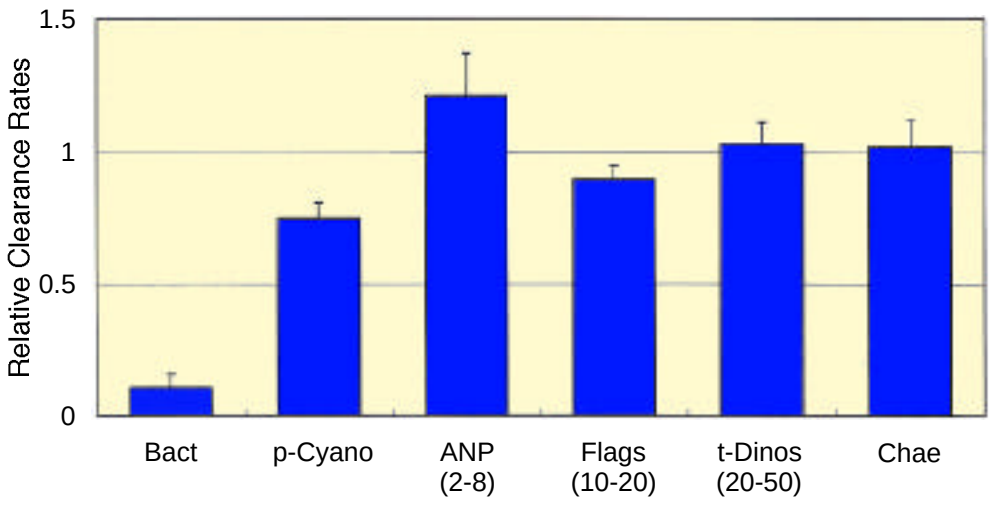


Fig. 1
Ruditapes philippinarum. Ratio of weight-specific clearance rates for each prey item to that for *Nitzschia* spp. (70-80 µm long). Vertical error bars show the standard error. Prey items are free-living bacteria (Bact; ca. 0.4 µm long), picocyanobacteria (p-Cyano; ca. 1 µm long), autotrophic nanoplankton (ANP), flagellates (Flags), thecate dinoflagellates (t-Dinos), and *Chaetoceros* spp. (Chae; chain forming). Their sizes (µm) are in parentheses.

vertical flux of organic carbon averaged over the experimental period (0.7 g-C m^{-2} d^{-1}). This indicates that the muddy sediment area in the Seto Inland Sea plays an important role in the degradation of organic materials supplied from the water column.

Lake Conservation Research Team

A steady increase in recalcitrant dissolved organic matter (DOM)–defined as the DOM remaining after 100 d aerobic incubation–has been observed in several lakes in Japan, such as Lake Biwa, and may be a new type of lake-water pollution. The accumulation of recalcitrant DOM in lake water clearly influences the way that environmental protection of lakes should be managed; this phenomenon is new and has not been given any previous consideration. It also presents a serious challenge for drinking-water management. Recalcitrant DOM could be a major precursor of trihalomethanes (THM) produced during chlorination in water treatment. Therefore, evaluation of the characteristics of DOM in lake water is urgently needed.

To examine the characteristics and dynamics of DOM in lake water, we developed a method by which DOM is separated into well-characterized macro-fractions. Using this fractionation method, DOM in water from eutrophic Lake Kasumigaura, its inflowing rivers, and several other DOM sources in the lake catchment area was fractionated into 5 classes: aquatic humic substances (AHS), hydrophobic neutrals (HoN), hydrophilic acids (HiA), bases (BaS), and hydrophilic neutrals (HiN).

DOM-fraction distribution patterns were significantly different depending on the origin of the sample (Fig. 2). AHS and HiA were the dominant fractions in DOM in all samples studied. HiA prevailed over AHS in the lake water, whereas AHS were slightly more abundant than HiA in the river waters. AHS were in the great majority in forest streams and plowed-field percolates. HiA abounded in paddy-field outflow, domestic sewage, and sewage-treatment-plant effluent. Only domestic sewage contained a significant amount of HoN, indicating the presence of linear alkylbenzene sulfonate (LAS)-like DOM.

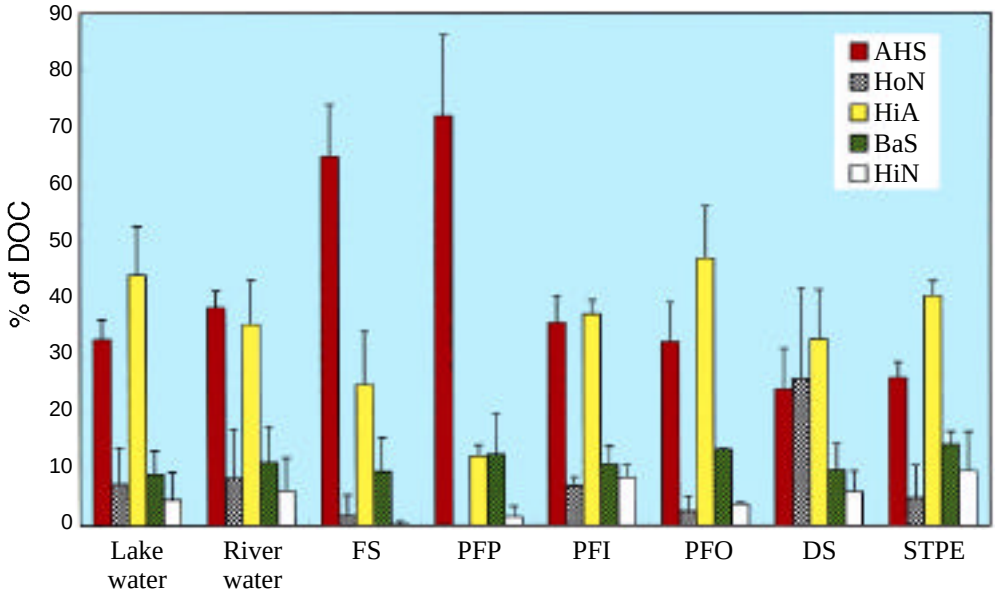


Fig. 2
Dissolved organic matter (DOM) fractionation of water samples from the center of Lake Kasumigaura, inflowing rivers, and other DOM sources in the lake's catchment area. DOM fractions are: AHS, aquatic humic substances;HoN, hydrophobic neutrals; HiA, hydrophilic acids; BaS, bases; HiN, hydrophilic neutrals. DOM sources are: FS, forest streams; PFP, plowed-field percolate; PFI, paddy-field inflow; PFO, paddy-field outflow; DS, domestic sewage; STPE, sewage-treatment-plant effluent. Error bars represent ± 1 standard deviation of the mean except for PFI and PFO; bars for PFI and PFO represent relative deviation of the mean (| measurement-average |).

Hazardous Waste Research Team

This team has undertaken experiments, using model wastes and small-scale landfills, to determine the mechanisms by which hazardous chemical compounds elute from landfills. We are also developing a methodology for monitoring toxicity.

We investigated patterns of dioxins eluted with water from bottom ash and flyash collected from municipal incinerators. We filled separate columns (60 cm i.d., 65 cm height) with bottom ash (41.52 kg) and flyash (34.65 kg) mixed with water, and slowly passed water through the columns. Dioxins in the eluted solutions were extracted with solid-phase extraction and determined by gas chromatography-mass spectrometry with an isotope dilution technique. We carried out this elution experiment over 1 year and took 6 sample fractions (10-12 *l*) from each column. In fraction #1 from the flyash column, the dioxin concentration rose by the initial drainage. However, the dioxin concentration became very low in fractions #2 to #6. The pattern of dioxin homologues in fraction #1 showed that homologues with many chlorine atoms tended to be the dominant PCDDs and PCDFs. In the elution from the bottom ash column, on the other hand, the initial drainage was not observed and it was noteworthy that only O8CDD concentrations were high. Dioxin concentrations in fraction #1 from the bottom ash column were not high except for O8CDD, and elution of low levels of dioxins continued for a long time. We estimate that the toxicity equivalent after fraction #4 was less than 1 pg l^{-1}, which is the environmental water regulation criterion. Therefore, we conclude that dioxin elution from reclaimed land would not be significant if the initial drainage from the landfill escapes.

Previous studies have shown high concentrations of 1,4-dioxane in leachates from many landfill sites. In this study, we collected samples of leachates monthly from 2 areas of reclaimed land and detected 1,4-dioxane in all samples. However, the origin of the 1,4-dioxane is still uncertain. We collected samples of bottom ash and waste plastics from this area of reclaimed land, shook them with water, and then determined the 1,4-dioxane concentration in the water solution. The waste plastics we collected here had been compressed and a heating process had been applied to further decrease the volume before they were dumped into the reclamation site. Our analysis detected 1,4-dioxane from bottom ash and from all waste plastics collected from this site. On the other hand, we detected 1,4-dioxane in only 2 samples of 26 kinds of plastic collected from the other waste management company that had not used a heating process to compress the plastics. At each site, 1,4-dioxane concentration from the dissolution test and 1,4-dioxane concentrations in the leachates were at equal levels. One of the mechanisms by which 1,4-dioxane is formed might, therefore, be the heating process or incineration.

As a model landfill experiment, we packed a mixture of bottom ash and plastics into a glass cylinder and analyzed the leachates for pH, electric conductivity, COD, inorganic elements, and organic components. Our analysis proved that 1) organic components in plastics were dissolved in water and lowered pH, 2) bisphenol A continued to elute after 2 years, and 3) within the inorganic component, there was a monotonous decline in concentrations of sodium, potassium and calcium, and on aluminum and boron fixed.

Water Quality Renovation Technology Research Team

This team previously studied the contamination of soil and groundwater with hazardous chemicals. Since FY 1996, the Team has filled the role of an ad-hoc project team to manage a new interdisciplinary area, entitled "Life-Cycle Assessment (LCA) of Environmental Burdens and Impacts Originating from Transportation and Waste Management Systems". The study worked toward the development of comprehensive environmental impact assessment methodology from the life-cycle point of view in two areas of concern: fundamental methodologies for life-cycle impact assessment (LCIA) and the application of such methodologies to case studies of transportation and waste management systems. In FY 1999, the Team continued its role as an ad-hoc interdisciplinary project team to manage a new research project entitled "Development of an Integrated Information System for Assessment and Management of Various Risks Including Environmental Endocrine Disrupters".

In the first year of this new 3-year project, the following studies were carried out. An integrated information system named the "virtual world" was developed, based on a geographic information system (GIS), in order to support risk assessment and risk management of various chemical substances at local and regional levels. The system consists of models for emission, fate prediction and exposure assessment, and databases for emission inventories, environmental monitoring, and observed effects on humans and ecosystems. Data collection for the system focused on emission sources of dioxins and their concentration in several media, as well as the environmental concentration of endocrine disrupting substances. Software tools were developed to support the analysis of these data in various geographical units, e.g. water basins and sewage systems. In addition, substance flow analysis was applied to plastic andditives, to seek possible sources of their release to the environment by tracing the flow of the substances "from cradle to grave". Geographic analysis of demographic and epidemiological data was also conducted.

The study in FY 2000 continued the topics described above; however, this year the study mainly focused on the development of an environmental modeling system for river water quality and the multimedia fate of chemicals. We defined the fundamental data structure of a river catchment system and developed a system for modeling river water quality based on this structure. We also defined the data structures for the necessary geographical, river, and chemical properties.

Air Pollutants Health Effects Research Team

This team has been investigating the role and risks of suspended particulate matter, such as diesel exhaust particles (DEP), diesel exhaust, and PM2.5 (particulate matter smaller than 2.5 μm), in the pathogenesis of pulmonary and cardiovascular diseases.

In FY 1999, we started a special program on the effects of PM2.5, especially DEP, on the pulmonary and cardiovascular systems. The program has the following sub-themes: 1) electrophysiology of pulmonary and cardiovascular functioning, 2) pathology of the cardiovascular system, 3) pharmacology of toxicity and toxicity dosage in the cardiovascular system, 4) biochemistry of cardiac cells and blood endothelial cells exposed to PM2.5 *in vitro*, 5) immunology of tissue and cell damage, and 6) evaluation of overall risk to human health from exposure to PM2.5.

DEP, intravenously injected into rats, induced cardiac arrhythmia –such as ventricular premature and atrioventricular (AV) block– and a spontaneous decrease in blood pressure. The difference in response between the groups administered DEP at levels higher than 50 mg kg^{-1} and the control group was significantly dose-dependent. Pharmacological investigations with guinea pigs showed that arrhythmia was first induced at 75.5 mg kg^{-1} and the lethal dose was 132.0 mg kg^{-1}. Pathological analysis of guinea pigs showed that DEP were present in the small arterial endothelial cells following acute exposure. A subcutaneous injection of a low dose of DEP induced abortions in C57Black mice, suggesting that DEP might contain substances that affect the reproductive system. Intratracheally introduced DEP enhanced lung injury related to bacterial inflammation. These results clearly suggest that DEP exposure may cause toxic effects in the pulmonary, cardiovascular, and reproductive systems. We are now conducting more detailed research and an inhalation study.

Chemical Exposure and Health Effects Research Team

This team is in charge of the millennium dioxin research project titled “Exposure and Health Effect Assessment of Dioxins” from FY 2000. The purpose of this research project is to obtain basal data to assess the health risks of dioxins, especially their effects on reproduction and development in humans, by investigating the relationship between body burden of dioxins and biomarkers for health effects.

In FY 2000, in collaboration with the Obstetrics and Gynecology Department of Tokyo University and with the informed consent of the women concerned, we measured concentrations of dioxins in amniotic fluid to assess fetal exposure to dioxins. The median concentration of dioxins in amniotic fluid was 0.011 pg TEQ g-wet^{-1} (range 0.002-0.066 pg TEQ g-wet^{-1}). This dioxin level was one fourth that of adult serum concentration. The placental barrier does exist; however, fetuses are exposed to a certain amount of dioxins *in utero*.

Drug metabolizing enzyme genes (*CYP1A1* and *CYP1B1*) are sensitively induced by dioxins and related compounds via mechanisms mediated by the aryl hydrocarbon (Ah) receptor. Analyzing the expression of these dioxin-inducible *CYP* genes in humans may provide useful information on dose-response relationships between human exposure to dioxins and the biological responses as well as a method to assess the variability of human response. We therefore have developed a quantitative reverse-transcription polymerase chain reaction (RT-PCR) assay using a real-time fluorogenic detection system. This real-time RT-PCR method has advantages over conventional methods in terms of performance, accuracy, sensitivity, wide dynamic range, and high-throughput capacity. Using this newly established quantitative RT-PCR assay method, we examined the profiles of *CYP1A1* and *CYP1B1* gene expression in the blood of 71 people in 2 population groups, incinerator workers (Group A) and reference subjects (Group B). Group A exhibited quite large inter-individual variations in the mRNA levels of *CYP* genes compared to Group B. These inter-individual variations may, in part, reflect different levels of exposure to dioxins as well as to other PAH, although other contributing and confounding factors, such as genetic background, need to be clarified.

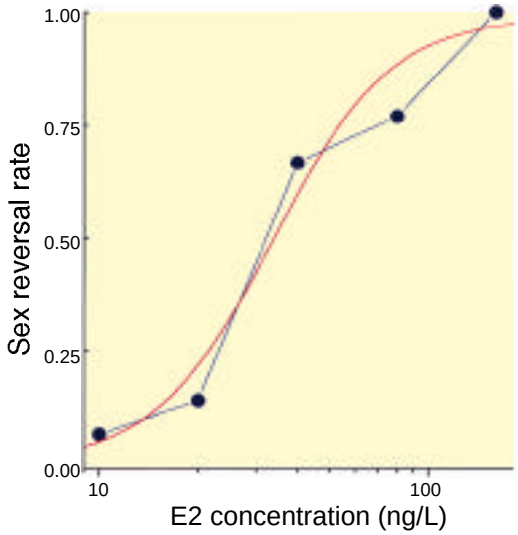


Fig. 3
Dose response curve of the sex reversal rate (%) of FLF strain medaka exposed to E2.

Ecological Hazard Assessment Research Team

This team is studying effects of chemical substances on aquatic organisms and ecosystems. We have applied a number of long- and short-term test methods to assess the effects of endocrine-disrupting chemicals on reproduction of aquatic test organisms. We assessed the effects of 17 β-estradiol (E2) and bisphenol A on the sex reversal and/or reproduction of 2 mutant strains of medaka (*Oryzias latipes*), drR and FLF. With the FLF strain, a fluorescent microscope can be used to distinguish genetic males from females by the white-pigment leucophores, which are absent in genetic females, in the egg stage from days 3 to 5 after oviposition. We exposed FLF male fry to E2 for 6 d, from day 3 after hatching, at nominal concentrations ranging from 0 to 160 ng l^{-1}. After that, we reared the fry in clean water for 3 months, and then examined their phenotypic sex. The dose response curve of sex reversal (from male to female) is illustrated in Figure 3. All males changed to phenotypic females at E2 concentrations of 160 ng l^{-1}, as determined by the absence of male-characteristic papillae in the anal fins and/or the gonad morphology. The EC_{50}, effective concentration of 50% sex-reversal, of E2 was estimated to be 36.7 ng l^{-1} based on a regression curve generated by probit analysis.

We performed the following experiment to clarify the point when sensitivity to sex reversal from male to female in FLF medaka ended. We exposed fry (16 individuals per exposure group) to 200 ng l^{-1} E2 (nominal concentration) for 2 d; in each subsequent exposure group, the first day of exposure was shifted by 1-d intervals from day 1 (12 ± 12 h after hatching) to day 11 after hatching. After the exposure, the fishes were reared for approximately 3 months and their phenotypic sex was investigated (Figure 4). The sensitivity to the sex reversal was comparatively high in the first several days after hatching. The sex-reversal rate reached approximately 70% in the 2-d exposures and 100% in a 4-d exposure; however, the rate gradually decreased to 0% around 7 days after hatching. In addition, the reproductive potency of those which remained as males, even though more 50% sex reversal had occurred in the same exposure profile (Fig. 4, a, b, c), was not impaired judging from the fertilization rates of eggs produced from control females mated with the non-sex-reversed males. However, the reproduction of the females that had been sex-reversed from males was significantly impaired based on the number of eggs laid and their fertilization rates by mating with normal males.

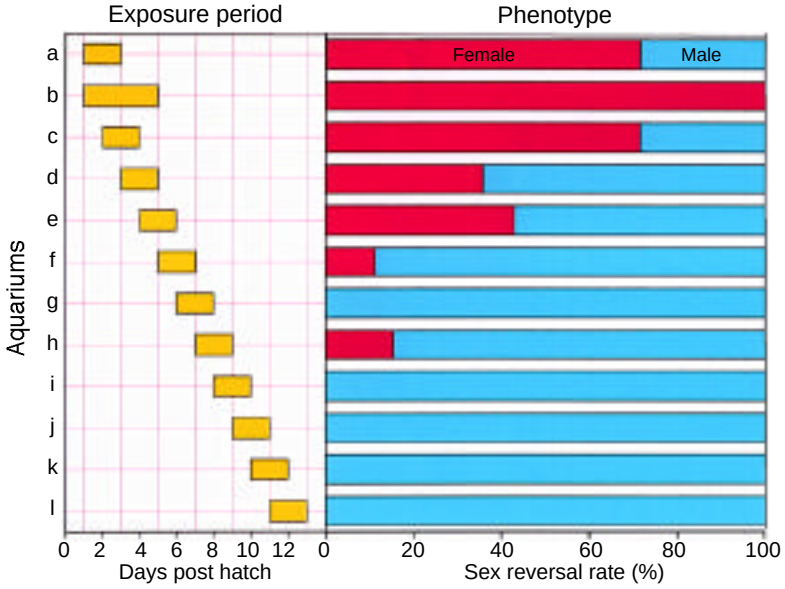


Fig. 4
Sex reversal rates (%) of FLF strain medaka exposed to 200 ng l^{-1} E2 in different exposure periods. Yellow bars (left) show the days after hatching when fish were exposed to E2. Red bars (right) indicate the ratio of sex reversal from male to female.

Biotechnology Products Assessment Research Team

This team studies the application of biotechnology to the preservation and restoration of the environment and the risks entailed. The approach is to produce genetically modified organisms useful for preservation or restoration of the environment and then to evaluate their impact.

Using a mercury removal-recovery system able to recover mercury volatilized by biological reduction we tested the removal of mercuric chloride from a mercury-containing buffer solution and soil by resting cells of the genetically engineered mercury-volatilizing bacterium, *Pseudomonas putida* PpY101/pSR134. Under optimum conditions, nearly 100% of the 40 mg l^{-1} of mercuric chloride was removed from the buffer solution and 70% was removed from the soil. The *P. putida* cells were immobilized on various immobilizing carriers to stabilize the mercury removal activity and to prevent the release of genetically engineered cells into the environment. We tested continuous removal of mercury with a semi-batch operation by immobilized cells.

Volatile aliphatic chlorinated compounds, such as trichloroethylene (TCE) and 1,1,1-trichloroethane (TCA), have been widely used as solvents; inappropriate disposal of these compounds has frequently resulted in contamination of groundwater. We isolated *Mycobacterium* sp. TA27 that can degrade TCE and TCA with ethane as its energy source. In this study, we determined the TCE and TCA metabolic pathways of strain TA27. The conversions to 2,2,2-trichloroethanol (TCAol), trichloroacetic acid (TCAA), chloral, and dichloroacetic acid (DCAA) derived from degraded TCE were 4.4%, 3.0%, 0.5%, and 0.4%, respectively. The production of TCAol, DCAA, and TCAA from the degradation of TCA suggested a novel pathway.

In plants exposed to ozone, the activity of 1-aminocyclopropane-1-carboxylate synthase (EC 4.4.1.14; ACS), which is the rate-limiting enzyme in the ethylene biosynthesis pathway, was induced after 1 h, while visible injury was not observed until 12 h later. Pre-treatment of plants with an inhibitor for ACS reduced visible damage caused by ozone exposure, suggesting that plants may be protected from ozone damage by suppressing the enzyme activity. Anti-sense DNA for ozone-

inducible ACS from tomato leaves (*LE-ACS6*) was introduced into tobacco leaves under the control of cauliflower mosaic virus 35S promoter. In 7 of the kanamycin-resistant T2 generations, ozone-induced ethylene production was reduced in 3 lines. Visible damage was reduced in the 3 lines and the extent of damage was related to the level of ozone-induced ethylene production in the transgenic lines. These results suggest that introduction of anti-sense DNA for *LE-ACS6* improved the ozone-stress tolerance of plants.

Ascorbate (ASA) has an important function in scavenging active oxygen that is produced as a result of some environmental stresses. We have isolated 2 complete cDNA clones for the ASA biosynthesis pathway from *Arabidopsis* seedlings: these correspond to genes for galactono-1,4-lactone dehydrogenase (*GLDH*) and GDP-mannose pyrophosphorylase (*GMP*). Transgenic plants that over-produce or down-express these genes have already been generated. Several transgenic lines were obtained independently and we are presently analyzing their ascorbate content and tolerance to environmental stresses.

Urban Environment and Health Research Team

This team has studied the effects on human health of various urban environmental factors, such as air pollution and electromagnetic fields (EMF).

Public concern regarding possible health risks from residential exposure to low level, extremely low frequency electromagnetic fields (ELF-EMF) produced by power lines has been increasing in recent years. We carried out a project entitled “Health Risk Assessments of Exposure to Extremely Low Frequency Electromagnetic Fields” from FY 1997 to FY 1999.

We built an EMF exposure facility in the Homotron (Community Health and Noise Effects Laboratory). The exposure room (approximately 3 × 3 × 3 m) was designed to optimize EMF field uniformity and to allow control of room temperature and humidity. The facility has a 4-coil system on each of the 3 orthogonal axes, north-south, east-west, and vertical. Volunteers were exposed to EMF, and we recorded the RR intervals (RRI) of their electrocardiograms. Within the range of 20 to 100 μT we did not find any consistent or dose-dependent trends in average RRI, coefficient of variance of RRI, or spectral powers of heart rate variance. We also exposed volunteers overnight to 50 Hz, 20 μT sinusoidal EMF + 3rd harmonic + 5th harmonic + transient 1 kHz, 100 μT (at peak). There were no statistically significant differences between serum melatonin or growth hormone in volunteers exposed to overnight EMF and those not exposed to overnight EMF. We also conducted a field survey of residences close to power lines to determine their exposure to extremely low frequency EMF. Our results showed that the ELF-EMF levels in the bedrooms of the houses depended on the distance from power lines, not on the usage of household electric appliances.

Comprehensive Risk Assessment & Bioassay Team

The main project of this team is to establish a comprehensive risk assessment system for environmental chemicals using various bioassays in combination. In particular, we have explored a novel biological index that represents the total hazard existing in the environment.

In FY 2000, we made further comparisons of several simple bioassays, including cytotoxicity tests using 5 different cell lines from humans and rodents tested against chemical mixtures consisting of 5 to 20 reference chemicals. In addition, we applied these simplified cytotoxicity testings, together with ecotoxicological testings, to the assessment of the total hazard existing in environmental water and wastewater samples. We compared the resultant bioassay data with conventional chemical analysis data. We also investigated the molecular mechanisms for induction of cell death by these chemicals to establish a new biomarker for cellular damage.

International Health Effects Research Team

This team was organized to assess the health risks associated with air pollution in Asian-Pacific countries, and to find effective risk-reduction strategies. International cooperative research on assessment of exposure to both indoor and outdoor air pollution was begun in China. Elevated levels of atmospheric pollutants from combustion of fossil fuels were found both indoors and outdoors.

Following these results, we started a new research project to estimate the health effects of urban air pollution and to find preventative options in China.

This project is focused on air pollution caused by smoke from coal combustion in urban energy producing centers, by smoke from various kinds of factories, and by automobiles. In particular, we will measure the concentrations of small, suspended particulates, so-called PM2.5, which have recently begun to attract attention as a significant health-risk factor.

In this study, we will carry out continuous air pollution monitoring to obtain the seasonal variations and regional differences in air pollution levels, and carry out a survey to evaluate personal exposure of residents to PM2.5, at 3 selected locations in the subject city. To clarify the long- and short-term influences on the respiratory functions of school children, we will use a standardized questionnaire together with intermittent use of a spirometer.

International Water Environment Renovation Research Team

The focus of this team is to protect the aquatic environment and to restore eutrophic lakes, reservoirs, and rivers using systems based on bioengineering and ecoengineering. The main research activities are described below.

This team is extensively studying model aquatic ecosystems, such as microcosms, to evaluate the behavior and effects of chemicals, microbial pesticides, agricultural chemicals, and genetically engineered microorganisms in bioengineered and ecoengineered systems. For microcosms consisting of microorganisms (micro-animals and algae as producers and bacteria as decomposers), we achieved very good reproducibility and results similar to those from our research on material cycles, energy-flow, and interactions in natural ecosystems. Based on our results, we are applying these approaches to predict the effects of chemical pollutants in natural ecosystems, such as lakes and marshes.

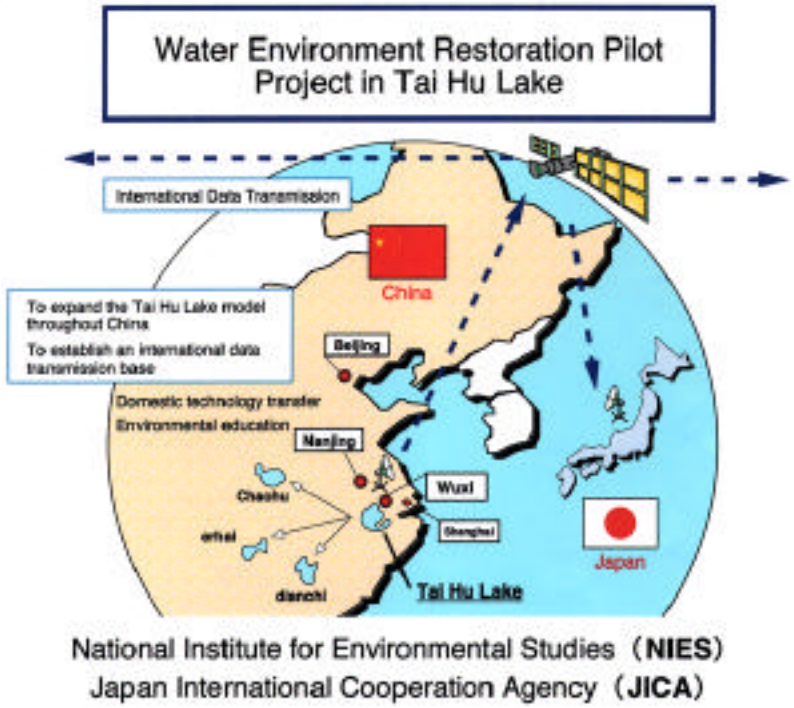


Fig. 5
International cooperation research project between Japan and China.

One very important joint research activity concerns restoration of aquatic environments in developing countries, such as China, Korea and Thailand, where populations are increasing and industrial activities are growing. Their aquatic environments have been rapidly polluted as a result of this growth. Figure 5 shows an outline of the Japan-China joint research on environmental restoration of Lake Taihu that will be implemented by ODA with JICA technical cooperation. The research includes transfer and improvement of wastewater treatment technologies and a survey of Chinese wastewater characteristics and ratios of pollutant levels. The International Water Environment Renovation Research Team participated in an exchange of opinions on the importance of introducing advanced domestic wastewater treatment systems. Through this work, our team is promoting development of aquatic environmental restoration in China by bioengineering and ecoengineering systems, such as aquatic-plant purification processes, soil treatment processes, and on-site domestic wastewater treatment processes.

International Ecosystem Management Research Team

This team has been investigating the functions of lacustrine and riverine landscape units in maintaining the diversity and integrity of aquatic organisms. Among the various landscape units, aquatic and riparian vegetation provides habitats to organisms, including plankton, fishes, birds and mammals, which enhance the biodiversity in the eco-regions at land-water interfaces. Complex geomorphic characteristics, such as channel meandering and pool-riffle sequences, are landscape units that are important in supporting such vegetation types and thus further enhance the biodiversity.

We investigated aquatic macrophytes, water quality, and phytoplankton community compositions in 3 lakes with different levels of vegetation coverage and nutrient concentrations on the Kushiro Moor during August 2000. Several species of endangered macrophytes (8 species in Lake Shirarutoro, 6 in Lake Takkobu, and 4 in Lake Toro) have probably become extinct since the previous investigation in 1991, for which ongoing eutrophication is suspected to be the primary cause. Linear

regression analyses of chlorophyll-*a* concentration versus limiting nutrients resulted in a significantly higher y-intercept and a lower slope for a lake with no submersed macrophytes (Lake Toro) than for a lake with abundant submersed macrophytes (Lake Takkobu), indicating differences in water quality, primary productivity, and food webs between lakes with and without the macrophytes. Correspondence analysis showed that 1) phytoplankton community structure differs between lakes with and without submersed macrophytes and that 2) the ordination of phytoplankton species was best explained by environmental gradients in variables such as TP and pH.

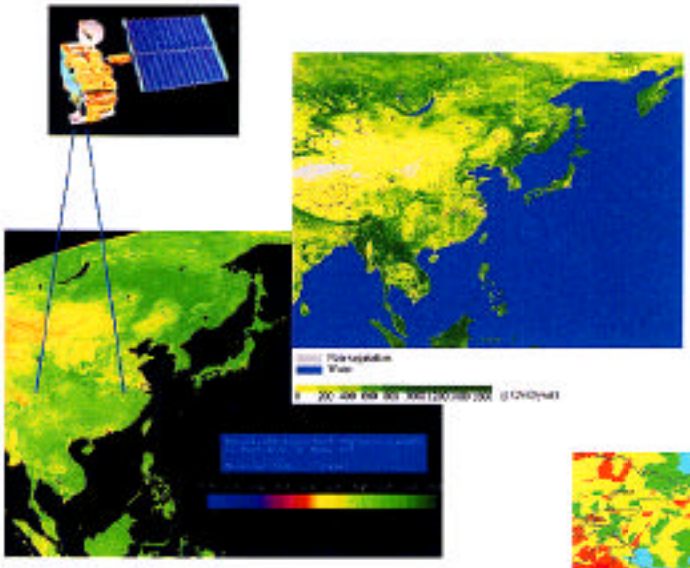
International Atmospheric Environment Research Team

This team is investigating the origins, chemodynamics, and reaction mechanisms of atmospheric aerosols in China, using a chemical mass balance method and a stable isotope ratios method.

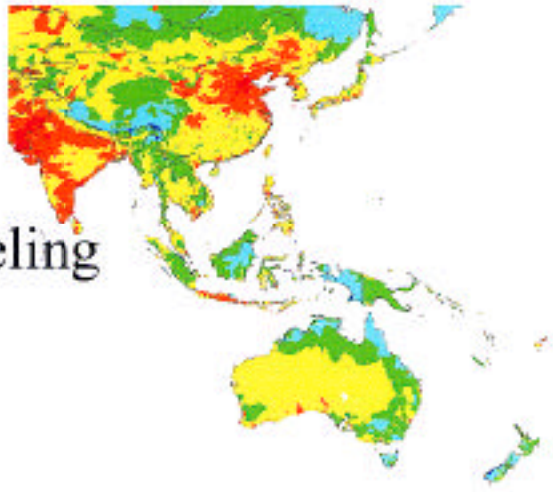
Big cities in those areas, for example Beijing, have been exposed to high atmospheric concentrations of anthropogenic aerosols as well as soil aerosols originating from desert/arid areas. One of our research topics is designed to increase basic understanding of the environmental behavior of the soil aerosol known as ‘kosa’. We estimated the ratio of the kosa aerosol content in the total urban aerosol by determining the aluminum and carbonate carbon concentrations. In spring, we estimated the content of mineral aerosols (such as the kosa aerosol) to be over 30% of the total aerosol, whereas we estimated the ratio to be less than 30% in summer and winter in Beijing. We have also been monitoring the fallout dust, which involves particles larger than the atmospheric aerosol, inside Beijing since 1998. We found that in all seasons the contribution of soil was higher in the fallout dust than it was in the atmospheric aerosols. Based on elemental comparison, over 50% of the mass of dust in spring has the same soil origins as the kosa aerosol.

We surveyed several arid areas in Inner Mongolia and various deserts for the origins of the kosa aerosol. We found the surface soil samples from loess areas in Yinchuan, Datong, and Xuanhua to have higher concentrations of carbonate than the other places, and these concentrations were close to those of the kosa aerosol and fallout dust in Beijing. It is strongly suggested that the development of techniques to restore desertification/land degradation in those areas will be useful in lessening the mineral aerosol in Beijing.

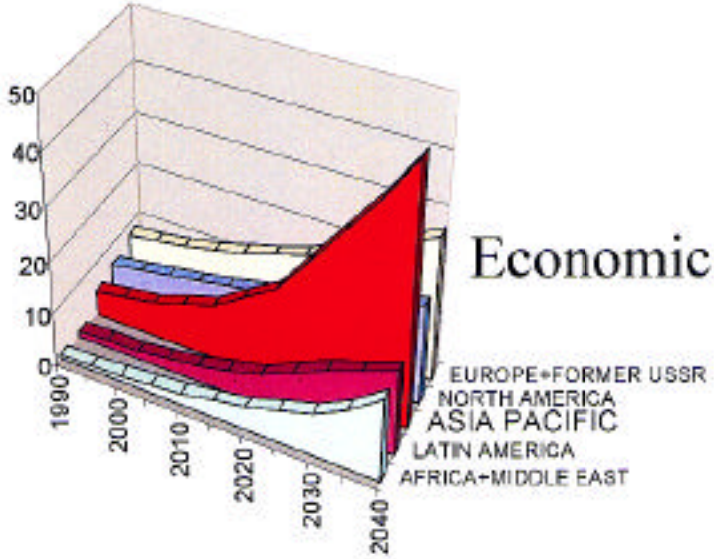
Social and Environmental Systems Division



Remote sensing



Physical modeling



Economic modeling

Environmental problems may be defined as those resulting from environmental changes that are consequences of various human activities. Whether these changes are pollution, physical degradation, or ecosystem destruction, they adversely affect or threaten our daily lives, well-being and socio-economic activities. Therefore, the human and societal dimensions of environmental changes are of the utmost importance for environmental protection and conservation. In this context, the Social and Environmental Systems Division is concerned primarily with present and future ways of interaction between social and environmental systems.

The Division consists of a Principal Researcher (PR) and 4 research sections– Environmental Economics (EE), Resources Management (RM), Environmental Planning (EP), and Information Processing and Analysis (IP). In FY 2000, these units conducted basic research on 9 topics.

Basic Research Topics of the Social and Environmental Systems Division

	Research Theme	Responsible Section
(1)	Fundamental Research on Perception of the Environment	(PR)
(2)	Analysis of the Impact of Environmental Policy on the Economy	(EE)
(3)	Institutions and Measures for the Development of International Coordination for Global Environmental Protection	(EE)
(4)	Analysis of Environmental Changes Associated with Development of Water Resources	(RM)
(5)	Assessment of Environmental Loads Associated with Material Cycling and Measures for Their Reduction Towards A Sustainable Society	(RM)
(6)	Environmental Planning Modeling Considering Local Conditions	(EP)
(7)	Information Processing Systems for Geographic and Image Data	(IP)
(8)	Modeling and Simulation Methodologies for Environmental Evaluation	(IP)
(9)	Consideration of the Human Dimension in the Value of Landscape	(EP)

Topic 1, which was conducted primarily by the Principal Researcher and his associate, deals with the effects of selected basic issues on people's awareness and perceptions of the environment. Regional environmental recognition and regional policy needs were clarified on the basis of theoretical discussion and analysis of various descriptions in free-association surveys that were conducted with local respondents near the Greater Seto Bridge.

Environmental Economics Section

In topic 2, we are continuing our study of the effects of a carbon tax on the macro-economy. In FY 2000, using our economic model, which has been improved and expanded from 10 to 17 sectors, including different transport and service sectors, we estimated the macro-economic impact of a carbon tax with regard to use of the tax revenue. In research topic 3, focusing on the Buenos Aires Action Plan established in 1998 and the "Clean Development Mechanism" proposed in the Kyoto Protocol, we analyzed the effects of climate policy options in relation to international negotiation processes after 2000.

Resources Management Section

In topic 4, we studied the impact of water resource development projects on water quality using as an example a project on a system to distribute water from a eutrophic resource. We investigated changes in water quality within the system and its surroundings as well as the impact on agricultural land and changes in the regional aquasphere. In addition, we investigated the use of communication tools for environmental monitoring with the participation of citizens.

Our society needs to undertake more environmentally oriented material cycling. Topic 5 deals with the development of a life-cycle assessment (LCA) methodology for assessing options to reduce environmental burdens, focusing on improvements in energy and material flows. We conducted case studies on beverage containers and on district heating/cooling systems by analyzing environmental burdens resulting from their production, use, and disposal. We also discussed simplification of the LCA methodology.

Environmental Planning Section

Improvement of local environmental plans is a central theme of topic 6. Many regional and local authorities, prefectural as well as municipal, are now engaged in formulating their own basic environmental plans in conformity with the National Basic Environment Plan. In addition, the latest national legislation on measures to prevent global warming requires intensive involvement of local authorities. In this regard, we have carefully identified and analyzed important common issues arising from the local planning process. In FY 2000, in a symposium of the Academic Society of Environmental Science, we discussed an environmental management system (EMS) for local authorities as a “local Agenda21” process. At that symposium, an EMS that includes partnership, characterized by external review and performance evaluation, was identified as having the potential to improve the EMS system currently used by local authorities.

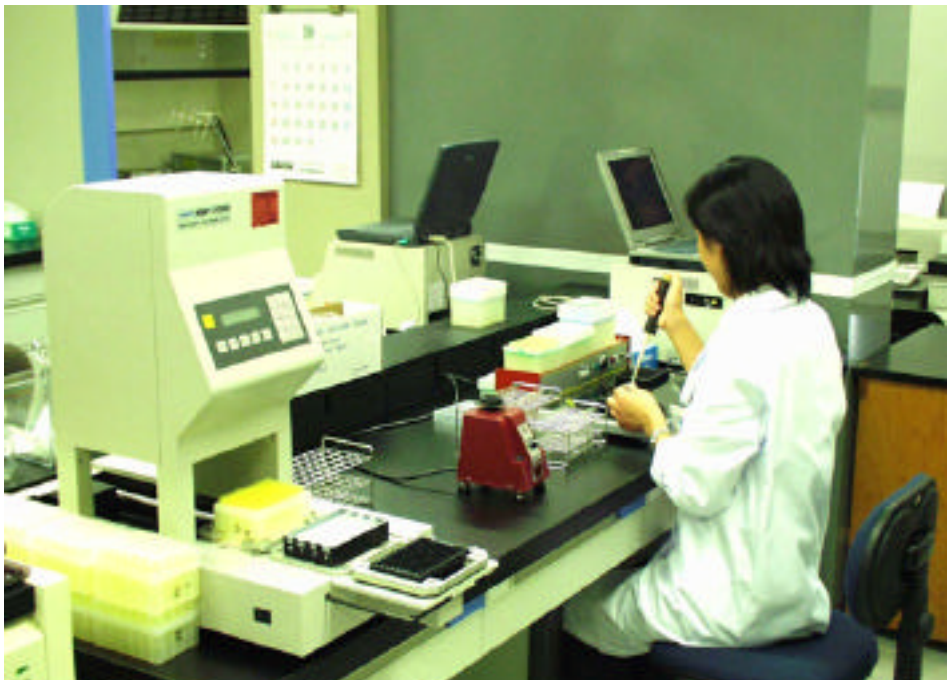
Landscape evaluation is the main theme of topic 9. We carried out and published an extensive review of descriptions of the Japanese landscape by westerners. We analyzed landscape descriptions by foreign visitors in the Meiji era to identify differences from landscape descriptions by Japanese people.

Information Processing and Analysis Section

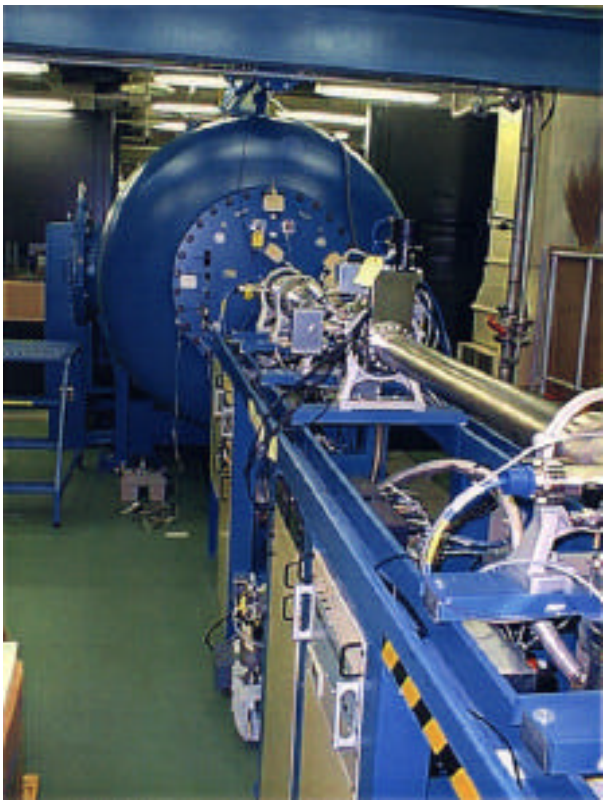
In topic 7, we applied advanced information processing techniques to analyze satellite imagery and geographic data in a number of studies. 1) Using satellite tracking and remote sensing techniques, we studied migration routes and habitats of endangered birds (red-crowned cranes and oriental white storks) in East Asia. We used a satellite tracking system to automatically obtain bird location data, from which we identified migration routes and important habitats. We used satellite remote sensing to investigate the environmental conditions of the habitats. 2) We used satellite images to study coral bleaching that occurred in the seashore of the Yaeyama-retto Islands in the summer of 1998. We found that coral bleaching could be detected by LANDSAT/TM images. 3) We estimated vegetation Net Primary Productivity (NPP) in East Asia by using the BIOME-BGC model. We used the Normalized Difference Vegetation Index (NDVI) dataset generated from NOAA/AVHRR data as input data to the model, together with meteorological and soil data.

Topic 8 focuses on development of models to analyze and quantitatively evaluate environmental changes, and on development of simulations based on these models, incorporating a new transformation technique to predict changes. Using the boundary-element method, we developed and improved an elaborate traffic-noise propagation model. The model simulated noise propagation under complicated environmental conditions more precisely than conventional models did. In addition, we investigated methods for statistical analysis in the processing of environmental data.

Environmental Chemistry Division



Assaying antagonists to estrogen receptors by using yeast 2-hybrid system



High voltage generator of accelerator mass spectrometer

Environmental contamination by various toxic chemicals that threaten human health and wildlife, such as dioxins and endocrine-disrupting chemicals, emphasizes the importance of risk assessment and management of chemical substances. To provide a scientific basis for the risk assessment of chemical contamination, the Environmental Chemistry Division conducts fundamental research on measurement of environmental parameters and on the fates and toxicologies of chemicals. The Division consists of 4 sections: the Analytical Instrumentation and Methodology Section, which conducts research on analytical methods and instrumentation for environmental analysis, in particular using mass spectrometric systems; the Analytical Quality Assurance Section, which conducts research on standardization and quality assurance in environmental analysis; the Environmental Chemodynamics Section, which conducts research on isotope analyses and analyses of chemical states and speciation, as well as on the application of these analyses to understanding the environmental fates of chemicals; and the Chemical Toxicology Section, which conducts studies on the chemical structures and toxicities of both natural and anthropogenic toxic compounds.

In FY 2000, we implemented 7 basic research projects covering a wide range of environmental contamination by various chemicals. In addition, most members of the Division participated in many research projects in collaboration with other divisions of the Institute. Of particular interest were research projects concerning dioxins and endocrine-disrupting chemicals, in which Division researchers were core members of the research teams. In our Division, there are 2 ongoing programs supporting the environmental monitoring of chemicals: the Environmental Specimen Banking Program, and the Environmental Certified Reference Material (CRM) Program.

Below are brief accounts of some of the important results from the Division's research in 2000.

Development of a system for assaying antagonists to estrogen receptors by using yeast and its application to organotin compounds

We developed a system for assaying antagonists to estrogen receptors by using the yeast two-hybrid system incorporating a yeast toxicity test. The principle of the yeast antagonist test for estrogen receptors is to measure the inhibition of expression of β-galactosidase (b-GAL) by the competition reaction between a test chemical substance and β-estradiol added into the medium at 300 pM as a ligand for the receptors. The yeast toxicity test, which measures the residual activity of β-galactosidase using the test chemical alone, is designed to indicate the toxicity of the test chemical to yeast. Thus, by comparing the 2 results, we can determine both the general toxicity and the antagonist activity to estrogen receptors. We applied the yeast antagonist test for estrogen receptors to examine the antagonist activities of triphenyltin chloride (TPT) and tributyltin chloride (TBT) to estrogen receptors. For TPT, the EC_{50} value was 32 nM in the -S9 test and 250 nM in the +S9 test (Fig. 1). TBT showed antagonist activities to estrogen receptors in the -S9 test only, and the EC_{50} value was 560 nM. TPT and TBT showed no toxic effect over the concentration range tested in this study. An estrogen receptor binding test (ER-ELISA) also showed that TPT and TBT were positive. These results suggested that the promotion of imposex observed in

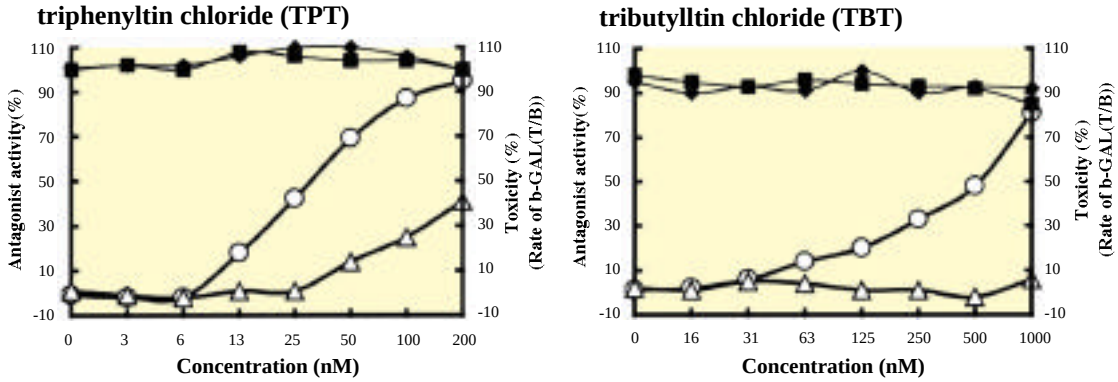


Fig. 1
Dose-response curves of antagonist activity and toxicity of triphenyltin chloride (TPT) and tributyltin chloride (TBT) of -S9 and +S9 using the yeast antagonist assay system for estrogen receptors. The values of antagonist activity are represented as the inhibited rate (%) of CLN intensity (T/B), and the values of toxicity are represented as the residual rate (%) of CLN intensity (T/B) of β-galactosidase. Antagonist activity of -S9 test (○), antagonist activity of +S9 test (Δ), toxicity of -S9 test (◆), and toxicity of +S9 test (■).

rock shells might be induced by the antagonist action of organotin compounds to estrogen receptors.

Global ocean thermohaline circulation during the last 5000 years as revealed by the dating of ancient animal bones by Accelerator Mass Spectrometry

The ocean is the largest reservoir in the carbon cycle on the surface of the earth. The radioisotope carbon-14 (^{14}C), naturally produced by cosmic ray action in the atmosphere, decays with a half-life of 5730 years during its transfer into the ocean and subsequent circulation with sea water. As a result, dissolved inorganic carbon (DIC) in the surface sea water generally contains smaller ratios of ^{14}C to the dominant stable isotope ^{12}C and shows greater ages, 400 years on average, than the CO_2 in the atmosphere. This age difference is termed the “marine reservoir effect”, and it shows local variation. Particularly greater ages, approximately 800 years, are shown in the North Pacific Ocean due to upwelling of old, deep-sea water in this region driven by the thermohaline circulation of the global sea water, a so-called “conveyer belt”. The conveyer belt controls the global climate by heat transfer, and the historical reconstruction of its movement is important to understanding global climate change.

As the degree of reservoir effect reflects the strength of this conveyer belt flow, we studied historical changes in the conveyer belt based on the ^{14}C age differences between terrestrial animals, which reflect the ^{14}C age of the atmospheric CO_2, and marine animals, which reflect the ^{14}C age of the oceanic DIC (Fig. 2). A ^{14}C age difference of about 800 years, derived from the analyses of bone collagen of deer and seals buried in the same layers, has remained nearly constant during the last 5000 years (Fig. 3). This suggests that the global thermohaline circulation (conveyer belt) has been moving fairly constantly during this period. In addition to this, by comparing ^{14}C contents of human bone collagen with those of deer and seal, we found that the major source of proteins for people living in this place 5000 years ago was of marine origin (80% from marine sources).

Surface alteration of naturally weathered biotite

The natural processes of rock and mineral weathering is a major research topic in earth and environmental sciences. Surface analytical techniques, such as secondary ion mass spectrometry (SIMS) and X-ray photoelectron spectroscopy (XPS), are useful tools with which to get clues on the mechanisms of chemical weathering, which is essentially a surface process. For a better understanding of the chemical weathering process, we used SIMS and XPS to examine surface alterations in laboratory weathered

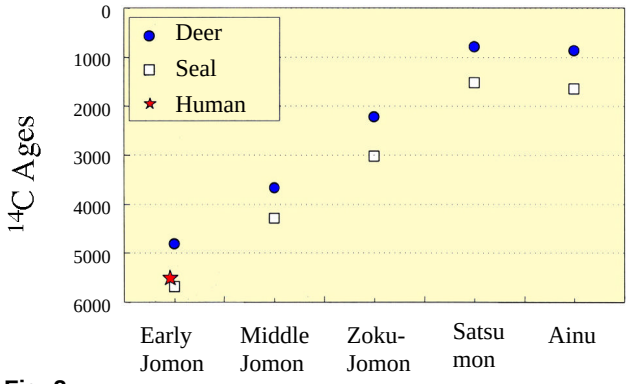


Fig. 2
Carbon cycling through the conveyer belt.

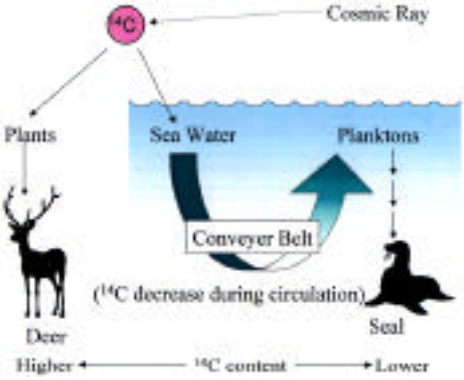


Fig. 3
^{14}C age difference between terrestrial animals and marine animals.

and naturally weathered biotite ($K(Fe,Mg)_3AlSi_3O_{10}$ $(OH,F)_2$), a common rock-forming aluminosilicate mineral. We collected naturally weathered biotite samples from Yakushima Island; from Inada, Ibaraki; and from around Mt. Pinatubo, the Philippines. The surface analysis of biotite treated with an acid solution (50 mM H_2SO_4) showed that Fe, Mg, K, and Al were selectively leached during acid dissolution, resulting in the formation of an altered surface layer rich in Si ($SiO_2\,nH_2O$). After acid dissolution for 1 week, we estimated the thickness of the altered surface layer to be about 100 nm. On the other hand, such a thick altered surface layer was not observed in the case of naturally weathered biotite. The SIMS depth profiles of naturally weathered samples indicated that Si was somewhat enriched and Fe and Mg were somewhat depleted in the surface layer (< 100 nm). In contrast to acid-leached biotite, Al was held in the surface layer under natural weathering. We attribute the differences in altered surface layers (thickness and chemical composition) between acid-leached and naturally weathered biotites to the acidity and dissolved components of the ambient solution.

Metabolism and biological effect of a cyanobacterial toxin (Dhb-microcystin)

Several genera and species of cyanobacteria (blue-green algae), which form massive growths (blooms and scums) in eutrophic lakes and reservoirs, produce cyclic heptapeptide hepatotoxins, known as microcystins. Microcystins are protein phosphatase inhibitors and are recognized to be liver tumor promoters. The WHO has adopted a provisional guideline value of 1.0 μg l^{-1} for microcystin-LR. Nodularin, an Adda- and Dhb-containing cyclic peptide toxin isolated from the brackish water cyanobacterium *Nodularia*, is not only a tumor promoter but also a carcinogen. Dhb-microcystins have been suggested to be carcinogenic because of their structural relationship with nodularin.

1) During our investigations of the toxic compounds in cyanobacteria, we found a new Dhb-microcystin from *Planktothrix*. The structure was elucidated by spectral data and chemical degradation.

2) We tested microcystin and Dhb-microcystin for reactivity with surfhydryl groups. We treated microcystin and Dhb-microcystin with glutathione in the same tube at alkaline pH. After 30 min, only microcystin reacted with glutathione. Even with overnight treatment, Dhb-microcystin did not react with glutathione. These results suggested that the metabolism of Dhb-microcystin is different from that of microcystin *in vivo*.

Environmental Health Sciences Division

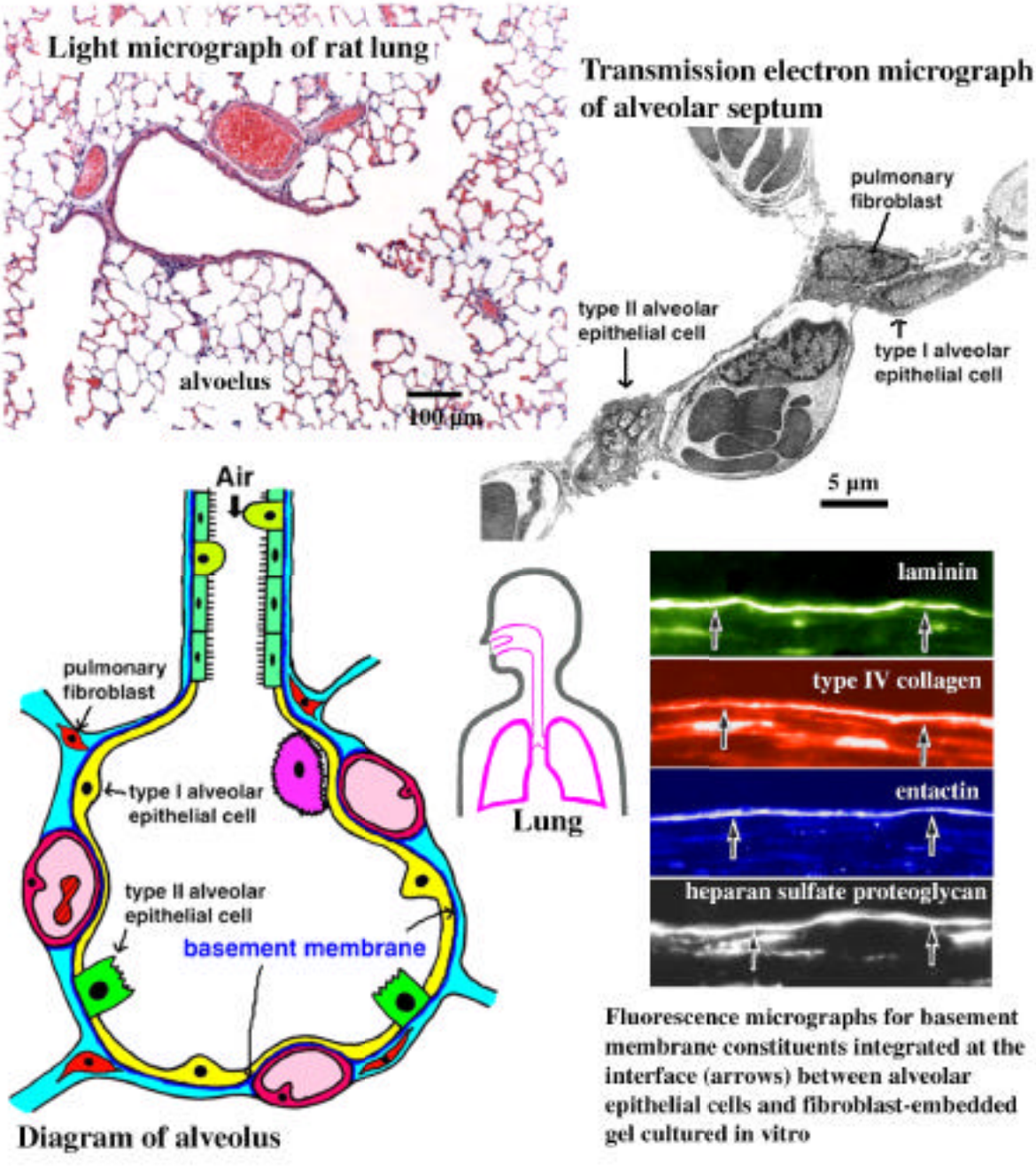


Diagram of alveolus

Fluorescence micrographs for basement membrane constituents integrated at the interface (arrows) between alveolar epithelial cells and fibroblast-embedded gel cultured in vitro

The mission of the Environmental Health Sciences Division is directed to studies on the possible effects on human health of harmful environmental chemicals –such as dioxins, environmental endocrine disruptors, heavy metals, and air pollutants– and physical agents, such as ultraviolet rays and electromagnetic fields. From this perspective, we aim to utilize the knowledge and information obtained from these studies to provide a scientific basis for risk assessment of these agents, alone or in combination. In this division, we have performed both epidemiological and experimental studies. In the latter studies, we have utilized laboratory animals as an experimental model for humans. Although the use of laboratory animals is essential to study how environmental chemicals affect humans, we recognize the importance of alternative experimental models that replace laboratory animals. This approach is thought to be appropriate not only for animal welfare but also for the innovation of new technologies to provide practical and convenient tools for basic understanding of toxicity mechanisms. This year's report of the Environmental Health Sciences Division focuses on one of our studies on the development of an *in vitro* cell-culture system that is intended to be used for inhalation toxicology.

The use of alveolar epithelial cell cultures is an easy and useful way of performing exposure assays *in vitro*. Alveoli in the lung are composed of types I and II alveolar epithelial cells, with endothelial cells in the capillaries and pulmonary fibroblasts in the interstitium. Beneath the alveolar epithelial cells lies a thin layer of basement membrane with a highly integrated architecture composed of extracellular matrix molecules. The basement membrane regulates cellular functions, such as migration, proliferation and differentiation, and acts as an air-blood barrier (Fig. 1). Although the basement membrane is recognized as important for the integrity of epithelial tissues, it is not sufficiently clear how the formation of the basement membrane is regulated under physiological conditions *in vivo*. Therefore, it has been difficult to reproduce *in vitro* epithelial tissues that reflect their *in vivo* structures and express their intrinsic functions. From the standpoint that formation of the basement membrane is crucial for *in vitro* epithelial tissues to perform their normal functions, we reproduced the pseudo-physiological conditions mimicking the cellular environments surrounding alveolar epithelial cells so that the cells could assemble the basement membrane *in vitro*.

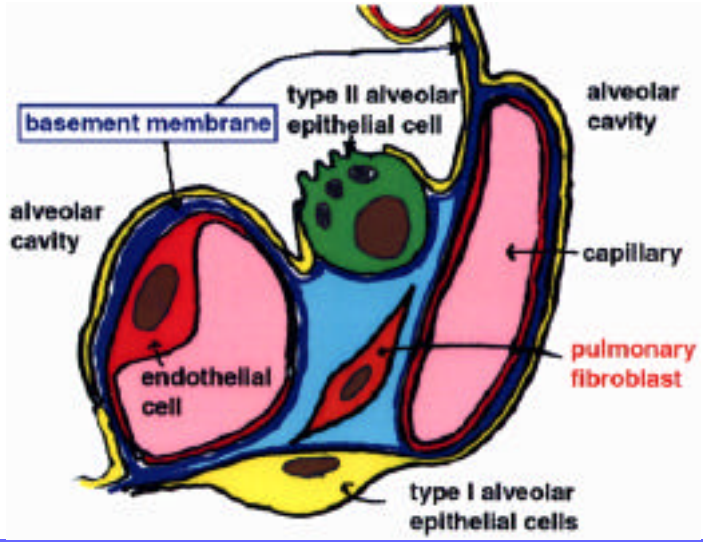


Fig. 1
Diagram of the alveolar septum.

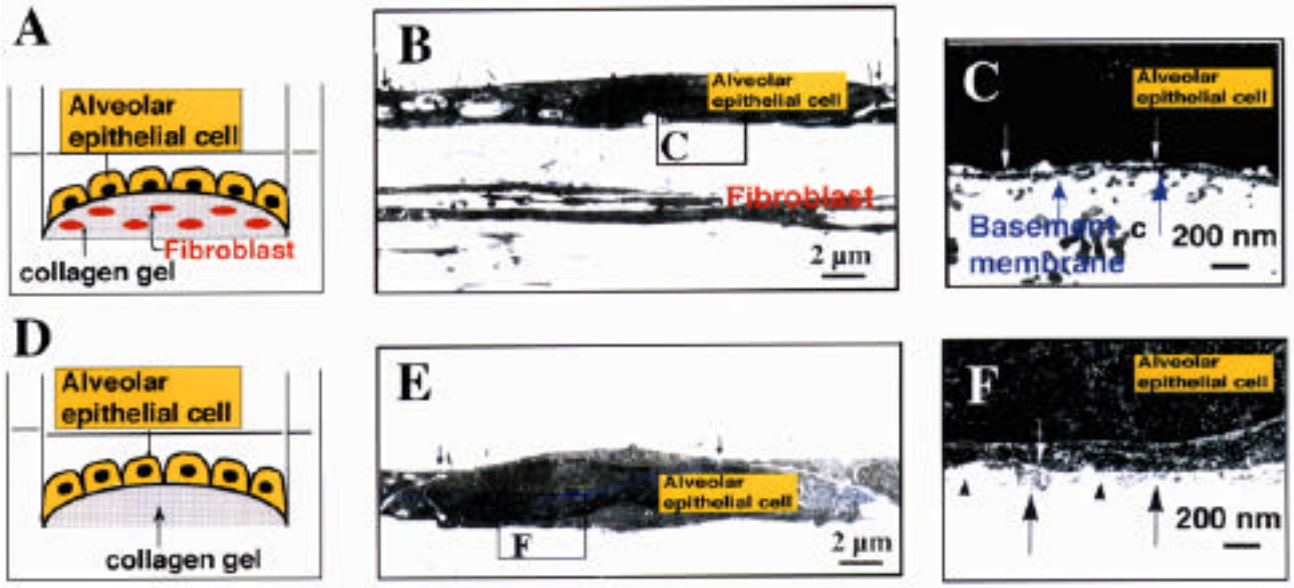


Fig. 2
Culture diagrams and transmission electron micrographs of co-cultures of alveolar epithelial cells with pulmonary fibroblasts (A, B and C) and alveolar epithelial cells alone (D, E and F). C and F are the enlarged photographs framed in B and D, respectively. Tight junction (small arrows), basement membrane (big arrows) and discontinuous sites of basement membrane (arrows heads) are indicated.

Mesenchyme-epithelium interaction is considered important for lung morphogenesis; therefore, we focused on the contribution of pulmonary fibroblasts as a partner in the formation of the basement membrane. Alveolar epithelial cells, when co-cultured with fibroblasts embedded in a collagen matrix, were able to form a continuous basement membrane structure (Fig. 2 A, B, C). Major constituents of the basement membrane, such as laminin, type IV collagen, entactin (nidogen) and heparan sulfate proteoglycan, accumulated in the basement membrane. Alveolar epithelial cells cultured alone on a collagen matrix could not achieve the formation of a continuous basement membrane (Fig. 2 D, E, F); deposits of major basement membrane constituents beneath alveolar epithelial cells were faint and discontinuous (Furuyama, A., Kimata, K. and Mochitate, K., Cell Struc. Func. 22, 603-614, 1997). We therefore succeeded in making an *in vitro* equivalent of the alveolus. Our results showed that fibroblasts play a crucial role in the formation of the basement membrane by alveolar epithelial cells.

Although a major role of pulmonary fibroblasts is to construct the extracellular matrix of the interstitium that maintains the integrity of pulmonary structure during ventilation, it is also probable that fibroblasts contribute to basement membrane formation by the secretion of basement membrane constituents. We investigated the role of pulmonary fibroblasts as an exogenous source of basement membrane constituents. Immunohistochemical study of fibroblasts and immunoprecipitation of fibroblast-conditioned medium revealed that fibroblasts secreted and deposited the major basement membrane constituents. Alveolar epithelial cells, when supplemented with exogenous laminin-1 and entactin, formed a continuous basement membrane beneath themselves (Fig. 3). These results showed that alveolar epithelial cells need exogenous laminin-1 and entactin to assemble them into the basement membrane and complete its formation (Furuyama, A. and Mochitate, K., J. Cell Sci. 113, 859-868, 2000).

In the development of the lung, various cytokines expressed may affect the behavior of alveolar epithelial cells; transforming growth factor-β1 (TGF-β1) is a representative cytokine involved in extracellular matrix metabolism and is released from fibroblasts. We studied the role of TGF-β1 from pulmonary fibroblasts in basement membrane

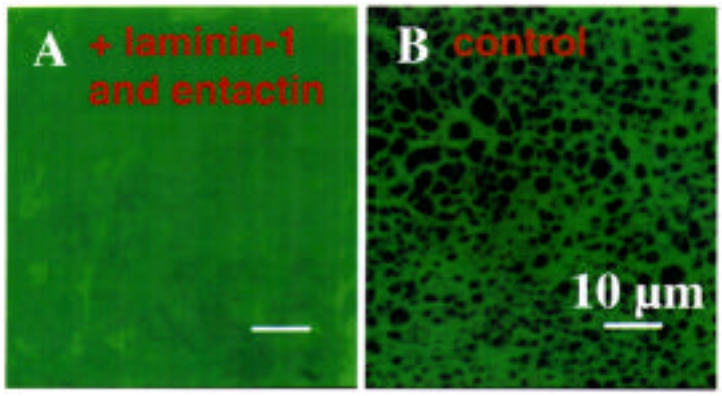


Fig. 3
Deposit of type IV collagen on basement membrane by alveolar epithelial cells supplemented (A) or not supplemented (B) with laminin-1 and entactin. Examination with a confocal laser scanning microscope.

formation by alveolar epithelial cells. Alveolar epithelial cells in culture supplemented with 1.0 mg/m*l* TGF-β1 formed a continuous basement membrane. Synthesis of basement membrane constituents was significantly enhanced in a dose-dependent manner by the addition of TGF-β1. TGF-β1 did not affect the synthesis of extracellular matrix-regulatory enzymes, such as type II transglutaminase, matrix metalloproteinase-2, plasminogen activator inhibitor-1, or tissue inhibitor of matrix metalloproteinase-1. However, formation of the basement membrane was inhibited at 5.0 ng/m*l* TGF-β1 by an increase in the amount of cellular fibronectin and type I collagen deposited beneath the alveolar epithelial cells. These results showed that TGF-β1 also regulates basement membrane formation by alveolar epithelial cells (Fig. 4) (Furuyama, A. et al., Eur. J. Cell Biol. 78, 867-875, 1999).

In summary, basement membrane formation is a typical collaboration between alveolar epithelial cells and pulmonary fibroblasts. Mesenchyme-epithelial interactions are indispensable for constructing the alveolar structure and for performing the physiological functions of the lung. The alveolar equivalent developed in this project can be used for *in vitro* research into tissue repair and is expected to be a useful tool to assess the effects of environmental pollutants on the lung.

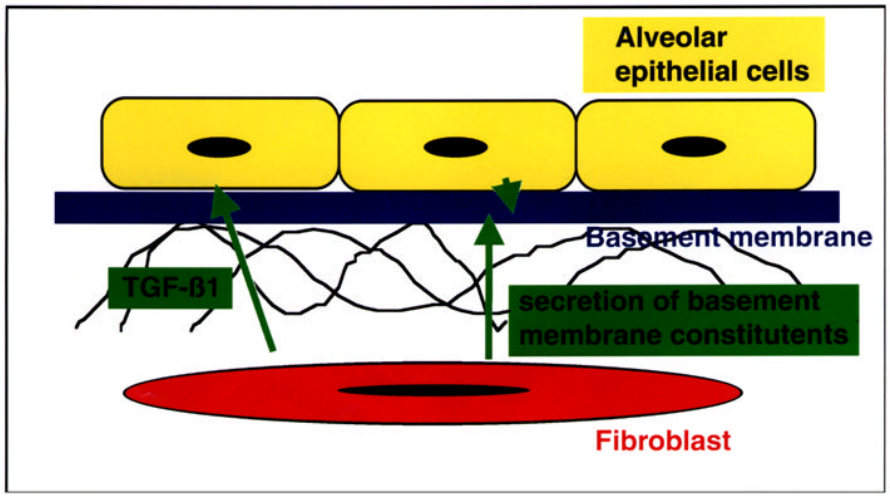
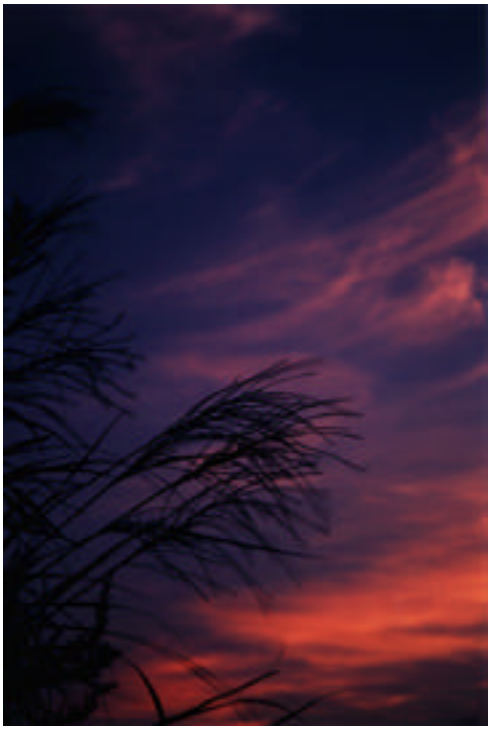
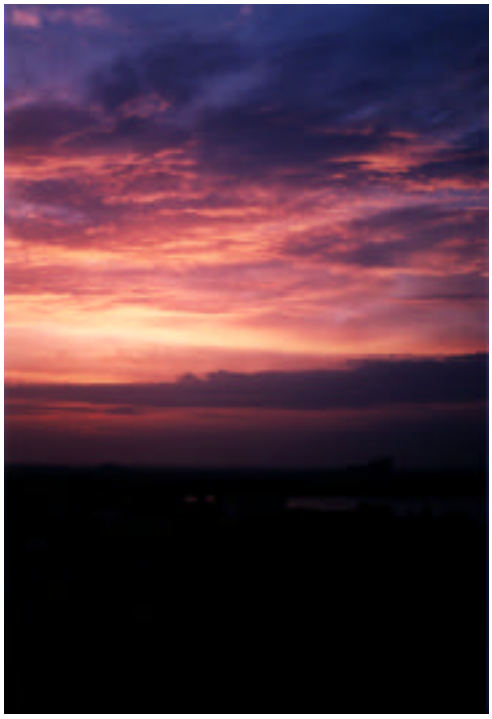


Fig. 4
Role of pulmonary fibroblasts in the basement membrane formation by alveolar epithelial cells.

Atmospheric Environment Division





The Atmospheric Environment Division conducts basic research on the distribution, properties, and reactions of atmospheric constituents including pollutants, as well as joint project studies with other divisions on, for example, the ozone layer, global warming, acid rain, satellite observations, and urban air quality. The Division consists of 4 sections whose research themes are briefly described below. Several experimental and measurement facilities, including a photochemical reaction chamber, a large-scale lidar (laser radar), an ozone lidar, an aerosol chamber and a wind tunnel, are operated for basic and applied studies in cooperation with the Global Environment Division.

Atmospheric Physics Section

Research in the Atmospheric Physics Section is focused on numerical modeling and data analysis of atmospheric dynamics and climate systems. A major research topic is analysis of the global and regional climate system using observational data and the CCSR/NIES climate model developed through joint research with the University of Tokyo (Fig. 1). The results facilitate studies of both global-and regional-scale environmental issues, such as the evaluation of climate change. Related research topics include evaluation of the direct and indirect effects of aerosols on global-scale climate change under conditions of increasing atmospheric greenhouse gases, and the development of a regional climate model that includes land surface processes in East Asia. Other specific research themes include derivation of tropospheric aerosol optical parameters from satellite image data, aerosol transport in the climate model, water exchange between atmosphere and land, improvement of parameterization of cumulus convection in climate models, global tracer transport in the stratospheric high latitudes associated with the polar vortex, and the transport of air pollutants in East Asia.

Chemical Reaction Section

The Chemical Reaction Section deals with chemical processes taking place in the atmosphere. We have carried out studies on the photochemistry of free radicals, studies on the kinetics and mechanisms of atmospheric reactions, and field observations of reactive species related to photochemical ozone formation, secondary aerosol transport, and acid deposition.

Gas-phase Reactions and Spectrometry of Radicals

Laser-induced fluorescence spectra of *trans*- and *cis*-2-chloro-vinoxy radicals (CHCl-CHO) were observed in the region of 320 to 360 nm. We produced the radicals by reacting oxygen atoms with chlorinated ethylenes, such as CH_2CHCl, CH_2CCl_2, CHClCHCl, and CHClCHF, and also by abstracting a hydrogen atom from

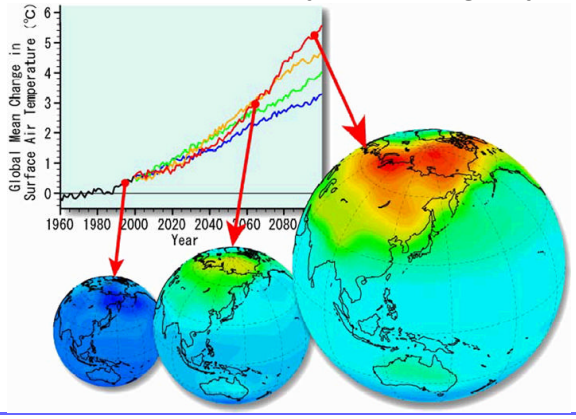


Fig. 1
Future projection of climate change using the CCSR/NIES climate model. Geographical distributions of the changes in surface air temperature from the present are shown for the most extreme case of warming predicted by numerical experiments based on 4 emission scenarios of greenhouse gases and aerosol sources.

chloroacetaldehyde with a Cl atom. We found that the C-C-O skeleton and spectroscopic character of the *cis*- and *trans*-CHClCHO were closer to CH_2CHO than to CH_2CFO which suggested that the reaction mechanisms of O + halogen-substituted olefins are similar to those of O + olefins.

We examined temperature-dependent photochemical ozone formation in a toluene/NO_x/dry-air/photoirradiation system. A chemical box model calculation suggested that the observed temperature-dependence could be explained in terms of the equilibrium reaction between an OH-adduct radical, O_2, and peroxy radicals.

Observations of Atmospheric Pollutants in Remote Islands and over the East China Sea

We monitored ozone and hydrocarbons on Okinawa Island. To get high time-resolution data for hydrocarbons, we set up an automatic sampling system that could collect samples at 4-h intervals at Cape Hedo. Low-molecular-weight hydrocarbons, such as ethane and propane, showed a cyclic variation with a frequency of a few days. It was clear that high concentration air masses came from continental Asia and that low concentration air masses came from the Pacific Ocean.

We carried out aircraft observation of atmospheric pollutants over the East China Sea. The Kosa event was visible and we observed high concentrations of SO_2 (> 10 ppb), NO_y (up to 15 ppb), and ozone (> 100 ppb). Sulfate concentration showed a good correlation with the concentrations of SO_2, NO_y, and PM2.5, but no correlation with PM10.

Upper-Atmospheric Environment Section

Researchers in the Upper-Atmospheric Environment Section study laser remote sensing methods, using such instruments as the lidar (laser radar), and conduct observational studies of the atmosphere using these methods.

We have conducted continuous observation with a compact ground-based lidar since 1996 in Tsukuba to study climatological features of distribution of aerosols and clouds. This year, we started observations in Nagasaki and Beijing in cooperation with Nagasaki University and the China-Japan Friendship Center for Environment Protection, respectively, to study transport of Asian dust aerosols (Fig. 2).

We also conducted observations with the lidar on board the research vessel “Mirai” in 3 cruises in the western Pacific. Latitudinal distribution features of aerosols and clouds were revealed. In the region below about lat 25˚N, large size sea-salt aerosols were dominant in the marine atmospheric boundary layer. In contrast, above lat 25˚N where westerly airstreams from the Asian continent prevail, the density of small aerosols was higher.

We developed a new bistatic lidar method for observing particle sizes in low-water clouds. The method utilizes scattering angle dependence of the polarization components on the particle size of the scatterer. After studying the method theoretically and experimentally, we developed the receiver system for the Mirai lidar.

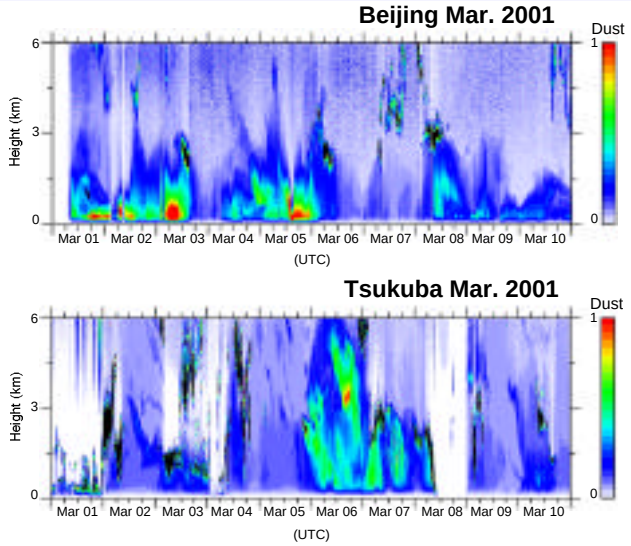


Fig. 2
Time-height indication of Asian dust aerosols observed in Beijing and Tsukuba. Asian dust events were observed in Japan with time lag of about 2 days.

We studied data analysis methods to retrieve optical parameters and distribution of aerosols and clouds for future satellite-borne Mie scattering lidars. We used the Monte Carlo method to study the effect of multiple scattering and to study a method of data retrieval that considers this effect. We also studied the multiple-field-of-view method utilizing the multiple scattering effect for the planned joint NASDA-ESA earth radiation mission.

Atmospheric Measurement Section

The special emphasis of the Atmospheric Measurement Section is on field studies of trace atmospheric constituents including greenhouse gases, reactive chemical species, and aerosols. To understand their origins, distribution and fate in the troposphere, we measured their concentrations and isotopic compositions on global and regional scales. In 2000, we continued measurements of greenhouse gas concentrations at Ochiishi and Hateruma Monitoring Stations. The average rates of increase in methane concentration for the period from 1996 to 2000 were found to be 4 ppb/yr at Ochiishi and 5 ppb/yr at Hateruma. However, a closer look at the variation in concentrations revealed that the increase was by no means uniform: the rate rose temporarily to 20 ppb/yr 1998 and then fell to -10 ppb/yr in 1999. The rate of increase in nitrous oxide concentration was 0.8 ppb/yr at Hateruma during 1996 and 2000; since 1999, it has shown an upward trend reaching 1 ppb/yr in 2000. We measured the abundance ratio of the stable isotope ^{13}C in carbon dioxide for air samples taken over Japan and Siberia. We found that the abundance ratio decreased significantly in 1998, but less in 1999; this observation corresponded to the behavior of the concentration, whose rate of increase was high in 1998 and low in 1999, and suggested that the net amount of exchange between the atmosphere and the terrestrial ecosystem varied over those 2 years.

We carried out artificial cloud experiments in a 430-m vertical mineshaft in Iwate Prefecture. In these experiments, clouds were formed in an updraft generated by an electric fan operated at the top of the shaft. Density and size of cloud droplets were varied by adding various kinds of condensation nuclei into the air stream at the bottom of the shaft. A model tree was placed at the top to study the occult deposition onto leaves, and we investigated, for example, the relation between the deposition amount and the wind velocity.

Water and Soil Environment Division

Kuchoro River Catchment (Hokkaido)

The Water and Soil Environment Division conducts both fundamental and applied research on transport, biological degradation, and chemical reactions of pesticides, organic matter, heavy metals, chlorinated aliphatic compounds, and 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 4 sections: the Water Environment Engineering Section, the Water Quality Science Section, the Soil Science Section, and the Geotechnical Engineering Section. We, in collaboration with members of the Global Environment and Regional Environment Divisions, currently use such experimental facilities as a fresh water microcosm, a marine microcosm, lysimeters, the Environmental Biotechnology Laboratory, and the Lake Kasumigaura Water Research Station.

Water Environment Engineering Section

Modeling and application of sediment routing in river catchments

Sediment transport not only causes the deformation of river morphology, but also changes terrestrial and aquatic ecosystems. Hence, control of sediment from upstream to downstream is indispensable to preserve and manage the aquatic environment and landscape in river catchments. River catchments consist of the river network itself together with various kind of land use. In this study, we proposed 2 mathematical models from the viewpoint of constructing a sediment routing model for entire river catchments.

(1) Two-dimensional flood propagation model

Fine sediment flowing into the Kushiro Mire has increased due to river channelization and agricultural development. Consequently the largest wetland in Japan has been gradually shrinking, causing the degradation of the environment in the mire. In order to predict the propagation of floods and fine sediment, we developed a 2-dimensional flood model, inclusive of the hydraulic resistance of vegetation and a diffusion model of cohesive fine sediment. The results, applied to the Kushiro Mire, showed that the calculated water level qualitatively corresponded to the measured data, which means that the hydraulic resistance of vegetation is significant.

(2) Sediment runoff model due to rainfall runoff processes

We theoretically examined a sediment discharge equation, which included the hydraulic effect of vegetation cover, based upon experiments with a rainfall simulator and previously obtained data. The sediment yield from slide of the surface soil layer was dynamically estimated based upon the stability analysis of steep slope. By applying the proposed model to the Kucyoro River catchment flowing into the Kushiro Mire, we showed that both the sediment yield and the transport of fine sediment throughout the river network is significantly influenced by the different land uses along the streams of the catchment.

Water Quality Science Section

Evaluation of the water purification function of an artificial reed field wetland created on dredged sediments

Several hundred wetlands have now been built throughout the world, primarily for

the purposes of improving water quality. It is widely recognized that wastewater treatment by using constructed wetlands is simple, effective, reliable, and economical. The objective of this study was to evaluate the water purification function of artificial reed field wetland ecosystems created on dredged sediments. We used reed fields planted with reed seedlings on dredged sediments for creating an artificial wetland pilot-plant.

The germination rate of the reed seedlings increased with temperature, and was independent of location, but decreased with increase of salinity. Low-temperature pre-treatment of seedlings at 5˚C before germination played an important role in overcoming the adverse effect of high salinity. The growth of seedlings on dredged sediments was good and stable during the 2-year experiment.

In addition, the results from using secondary wastewater to determine the purification function indicated that the removal rates of total nitrogen ranged between 0.1 and 1.3 g m^{-2} day^{-1} and the removal rate of the phosphorus ranged between 0.02 and 0.23 g m^{-2} day^{-1}. In summer, the removal rates of nitrogen and phosphorus increased to 1.1-1.5 and 0.2-0.3 g m^{-2} day^{-1}, respectively. These results suggest that the creation of reed fields with seedlings on dredged sediments might be applicable to large areas, including brackish-water areas.

Soil Science Section

Effects of heavy metal pollution from lead-free electronics wastes on soil ecosystems

Heavy metals are a principal source of environmental contamination. Various kinds of heavy metal contamination in the environment have recently begun escalating. Because of the concern about toxicity of lead to living things, materials once made of lead are now increasingly made of lead-free materials. As a result, use of bismuth, antimony, indium, silver, etc. will expand as they replace lead in many kinds of semiconductors or solders. Therefore, heavy metal contamination by these lead-replacement metals is expected to become serious in the future. However, we still lack information about these lead-replacement heavy metals, particularly their behaviors and toxicities.

In order to understand the behaviors and toxicities of these lead-replacement metals in soils, we set up undisturbed soil lysimeters (80 cm ϕ ×150 cm), which can determine the soil temperature, pF value, and collect soil solutions with depth. We collected soil cores for the lysimeters from Andosol in Tsukuba. Room temperature and soil temperature were controlled at 25 ˚C and 20 ˚C, respectively. We applied silver (Ag), indium (In), tin (Sn), antimony (Sb), and bismuth (Bi) to the lysimeter soils at 10 to 100 times their natural abundance.

We determined natural abundances of Ag, In, Sn, Sb, and Bi in this soil by ICP-MS after acid digestion by HNO_3 : $HClO_4$: HF = 1 : 1 : 1. Average concentrations in the A-horizon (0 to 60 cm depth) were as follows: Ag, 0.16 ± 0.01 ppm; In, 0.093 ± 0.007 ppm; Sn, 2.5 ± 0.2 ppm; Sb, 0.77 ± 0.05 ppm; and Bi, 0.33 ± 0.02 ppm. Average concentration of Bi in the B-horizon (60 to 180 cm depth) was 0.29 ± 0.01 ppm.

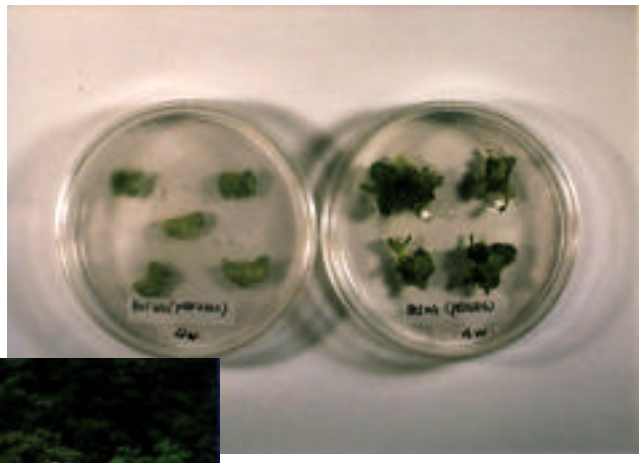
We investigated the effect of the lead-replacement metals on soil bacterial population growth in a 1/10 TSB solution media by using the MPN (most probable number) method. The population growth of the bacterial fraction was suppressed by 1 ppm of Ag and 50 ppm of Bi. So far, the accumulation of these 2 lead-replacement metals is not so serious that their abundances induce ecotoxicity. However, if large quantities of these metals accumulate in the soil, it will be detrimental to living things, which is the same as for other metals now considered detrimental.

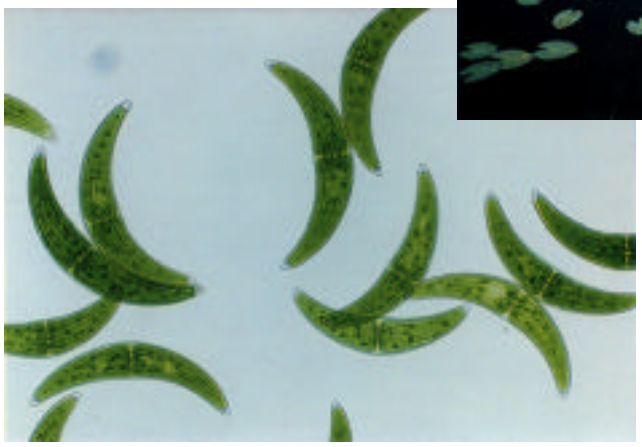
Geotechnical Engineering Section

Land subsidence in Takada, Joetsu, Japan

Urban Takada, situated south of the city of Joetsu in western Niigata Prefecture, is a typical heavy snowfall area in Japan. The groundwater level decreases greatly in winter, due to excessive pumping of groundwater to melt snow, resulting in subsidence caused by consolidation of Quaternary deposits. Recently, severe decline of the groundwater level of a confined aquifer at about 50 to 60 m deep, known as “G1 bed”, has occurred due to increase pumping of groundwater from wells there. The “C1 bed”, about 6 to 50 m deep, is mainly composed of very soft clay with humus, and accordingly its compressibility is large.

Environmental Biology Division





The Environmental Biology Division consists of 4 sections: Molecular Biology, Environmental Microbiology, Environmental Plant Science, and Ecosystem Study. The Division carries out basic and applied research on the effects of various environmental stresses, both chemical and physical, on organisms at various levels, from molecules and cells to individuals, species, populations, and ecosystems. The Division's work is also directed towards the conservation of genetic diversity, species, and ecosystems. In 2000, the Division performed 18 studies funded by NIES, 2 studies funded by the Environmental Research and Technology Division (Environment Agency), 1 study funded by the Science and Technology Agency, and 5 studies funded by the Japan Ministry of Education, Science and Culture.

Molecular Biology Section

Research in the Molecular Biology Section has included physiological and molecular biological studies on the mechanisms of plant tolerance to stress caused by various environmental conditions.

Ozone is considered the most phytotoxic air pollutant to which vegetation is exposed in the natural environment. Until now, assessments of the phytotoxicity of this pollutant have been performed largely based on estimates of visible leaf injury. We developed a novel method to detect and analyze the effects of ozone on plants that is more sensitive and specific than other methods currently available. This method is based on the detection of changes in expression of selected genes by cDNA microarray analysis. Using this method, shifts in gene expression in *Arabidopsis thaliana* induced by ozone exposure were shown to be distinct from those induced by drought or wounding, but similar to responses induced by UV-B irradiation (Fig. 1). These findings illustrate the potential of the cDNA microarray technique for detecting and analyzing the responses of plants to various stresses.

Environmental Microbiology Section

Research conducted in the Environmental Microbiology Section includes: 1) studies on microbial diversity, including genetic and morphological variations, potential biodiversity in nature, and functional diversity in microbial communities; 2)

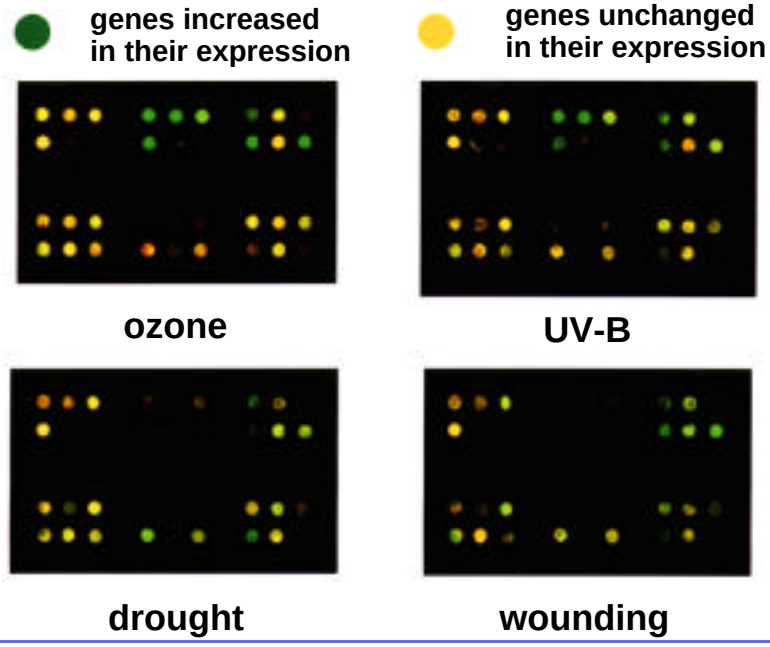


Fig. 1
Gene expression profiles of a cDNA microarray induced by ozone and other stress factors. Each spot at the same location exhibits the result of a single gene.

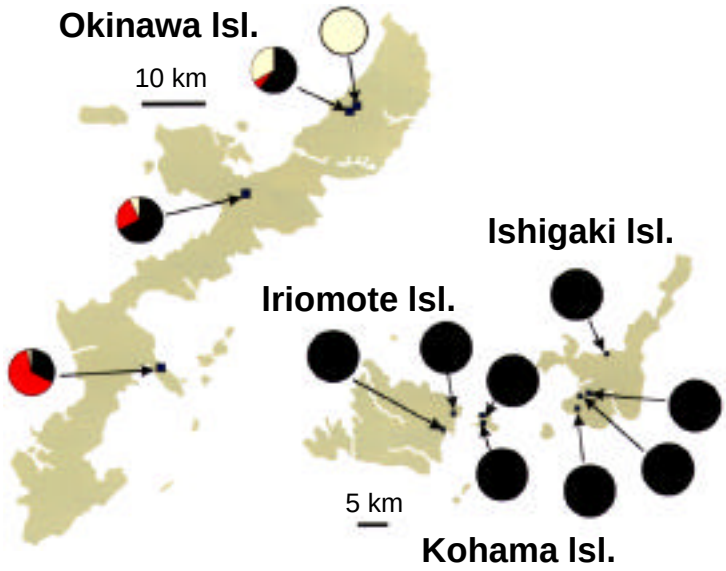


Fig. 2
Genetic structures of *Closterium ehrenbergii* from Okinawa Island and from the Sakishima Islands. We observed 3 patterns for phosphoglucomutase on Okinawa Island, whereas we observed only one pattern on the Sakishima Islands (Iriomote, Ishigaki, and Kohama).

management of the NIES-Microbial Culture Collection and the development of related techniques; 3) analyses of microbial activity in carbon and nutrient cycles; 4) development of genetic markers in microalgae; and 5) biodiversity and ecophysiological studies on coccolithophorids.

Microalgae often attract our attention when they make visible water blooms and produce harmful substances. However, microalgae are necessary for the integrity of aquatic ecosystems, their relationship with the carbon and nutrient cycles, etc. In addition, microalgae have been recognized as genetic resources that produce useful substances including industrial and food materials. Thus, we must pay attention to the preservation, as well as the control, of these organisms. For this purpose, it is necessary to analyze, and sometimes preserve, the genetic diversity of such microalgae, because genetic diversity is an important factor that influences occurrence and persistence of microalgal populations. We examined genetic variations in the microalga *Closterium ehrenbergii* using allozyme analyses. Among microalgae, whose species boundaries are not always well defined, this alga is considered an appropriate model organism for this kind of analysis. In *C. ehrenbergii*, the potential of genetic exchange has been clearly demonstrated between local populations. By analyzing the allozyme patterns of 3 enzymes, we showed that the genetic structure of *C. ehrenbergii* differed between 2 local populations, one in Okinawa Island and the other in the Sakishima Islands (Fig. 2).

Environmental Plant Science Section

In the Environmental Plant Science Section, we conducted research into 1) the effects of desertification and global warming on plants; 2) conservation of alpine and subalpine plant species; 3) the theoretical analysis of the dynamics of species diversity in an evolutionary context; and 4) simulation studies of the effects of climate change on forest dynamics.

Taxonomic groups with low taxonomic diversities are considered to be prone to extinction. However, “living fossils”, which have not exhibited any remarkable morphological change throughout their history, have survived for a long time with low taxonomic diversities. We carried out computer simulations of a food web system.

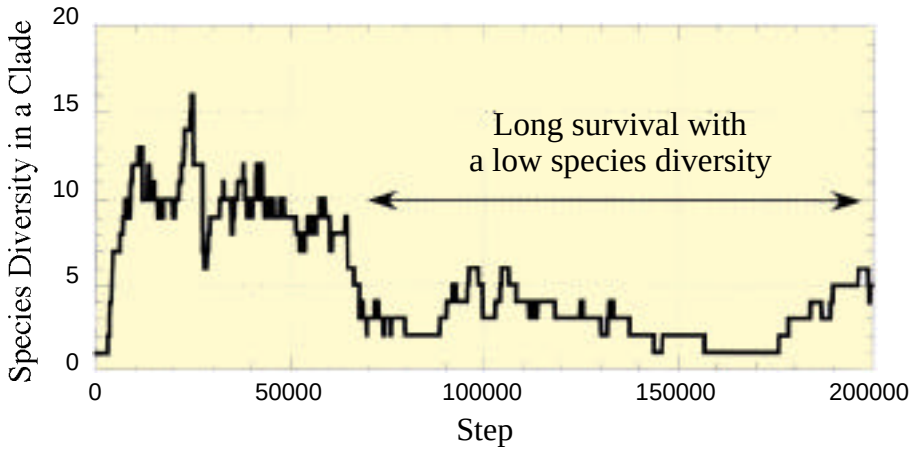


Fig. 3
Example of a "living fossil" clade.

Each species constituting the system feeds on others in accordance with its feeding preferences. The system evolves via evolution of species. In the system, clades (a clade is defined as a group of species derived from a common ancestor species) consisting of species with low evolutionary rates cannot increase their species diversities because of high predation pressure and intra-clade competition for food, factors both derived from their low evolutionary rates. However, because of the low species diversities, their predators soon become extinct due to lack of food. In addition, because of their low evolutionary rates, such clades sustainably utilize prey clades and, consequently, are provided with sufficient food. Such clades, therefore, survive for a long time with low species diversities (Fig. 3). This study strongly suggests that the low evolutionary rates of living fossils allow their long survival with low taxonomic diversities.

Ecosystem Study Section

Ecosystem research has included 1) studies on the process of restoration of disturbed ecotone ecosystems of lakes; 2) the significance of natural populations of firefly as an indicator of the state of the environment; 3) studies on habitats of benthos in the littoral zones of lakes; 4) fundamental studies on the classification and ecology of lotic macroinvertebrates; and 5) comparative studies on population dynamics of wetland macrophytes.

We investigated seasonal changes in the concentrations of total inorganic carbon (TIC) and dissolved organic carbon (DOC) in about 50 bog pools in the Ozegahara Mire of central Japan to study the limiting factors of growth of 2 floating-leaved plants, *Nuphar pumilum* var. ozeense and *Nymphaea tetragona*. The maximum TIC and DOC in the water were 3 and 20 mg-C L^{-1}, respectively. There was good correlation between the concentration of TIC and DOC in June, July, and October. Bog pools 0.5 m deep had a relative light intensity < 1% and had the highest concentrations of DOC. *Nuphar pumilum* var. *ozeense* with rhizome lengths < 10 cm and *Nymphaea tetragona* with rhizome lengths < 1 cm had only submerged leaves. There were many young plants and small plants without floating leaves in shallow pools with high DOC and in deeper pools (> 1 m) with intermediate concentrations of DOC. There were no floating-leaved plants in pools with low concentrations of TIC or DOC. High TIC was a positive growth factor providing a source of carbon for young plants of the 2 species. On the other hand, high DOC was a negative limiting factor on the growth of those plants due to the associated reduced light intensity.

Waste Management Research Division

Waste Issues and Research Objectives

Material cycles and waste management policy for solid waste in Japan began as a matter of public health in the latter part of the 20th century. The main purpose was to treat waste appropriately and safely to prevent infectious diseases resulting from microbes in waste. Since the 1960s, incineration facilities have been established by the specified planning schedule. The oil crisis in the 1970s forced us to consider waste as a potential energy source and prompted power generation by waste incineration. In the 1980s, warnings regarding the waste generated by the structure of our society based on industrial and consumption started to be heard. The Revised Waste Management Law enacted in 1991 was the first official legislation in Japan to give such a warning. This policy included the concepts of "waste avoidance" and "recycling" as measures of waste management; these concepts were added to the former waste management policy that had been based on "stabilization, reduction, and energy recovery". The principles behind the "Environmental Basic Law" drawn up in 1993 were material cycles, sustainable development, and international cooperation. In 2000, the "Basic Law for the Establishment of a Material Cycles Oriented Society" created a hierarchical system; that is, "priority is given to waste avoidance, reuse, recycling, proper treatment, and final disposal, in this order, as the basic principles of measures for waste management". This has become a basic tenet for various regulations and voluntary plans created by industrial circles and citizens' groups.

When the Central Government was reorganized in January 2001, waste management administration was unified under the aegis of the Ministry of the Environment. Along with this reform, the National Institute for Environmental Studies created the Waste Management Research Division on 6 January 2001 to promote waste and recycling studies. The research objectives at this division are to consider and present an overview of the Material Cycles Oriented Society and proper waste management methods. The division covers various aspects of waste issues, ranging from waste prevention to recycling, treatment and disposal of wastes. Our research encompasses basic studies of waste characterization, hazardous substance management and risk assessment, and practical research into technological control methods and system development and assessment. In April 2001, the Waste Management Research Division was renamed the Research Center for Material Cycles and Waste Management, the research conditions, which would be able to deal with environmental policies as well as basic studies, were readied to study how to create a desirable Material Cycles Oriented Society.

Research Sections for Fiscal Year 2000

From January to March 2001, research performed by the former Department of Waste Management Engineering at the Institute of Public Health was taken over by 3 NIES sections: the Waste Management Planning Section, the Waste Treatment and Recycling Section, and the Final Disposal Engineering Section. In addition, 2 research programs were carried out by the Hazardous Waste Assessment Section.

The Waste Management Planning Section has mainly studied methodological developments for prevention, recycling, treatment and disposal of waste, and has carried out risk management and created a waste management information database. The Waste Treatment and Recycling Section has engaged in developing process technologies in terms of recycling and treatment of waste, and has focused on constructing and operating facilities for these technologies. They have also proceeded to more in-depth research analyzing chemical processes during recycling and treatment, such as the formation and/or destruction and the prevention/removal of micro hazardous chemicals. The Final Disposal Engineering Section has performed research into risk reduction in final disposal sites and research into the arrangement, maintenance, and monitoring of the related facilities. In addition, they have focused on how to use landfill sites and technologies for remedying environmental damage. The Hazardous Waste Assessment Section has developed and evaluated test methods in waste management. It has investigated the status of environmental pollution by using chemical analyses to analyze the behavior of the wastes themselves and to analyze the formation mechanisms and behaviors of hazardous chemicals created during the treatment process. Basic studies concerning the formation of polychlorinated dioxins and dibenzofurans (PCDDs/DFs) in small-scale incineration clearly showed the possibility that inorganic sodium chloride could form PCDDs/DFs. The formation mechanism was also examined.

Formation mechanism of PCDDs/DFs in small-scale incineration

PCDDs/DFs are formed during combustion and flue gas treatment in incineration systems. There are few clear analyses on the formation mechanisms of PCDDs/DFs, because most studies have analyzed the entire incineration system as a single entity. This study focused on combustion in small-scale incinerators and considered how inorganic sodium chloride that combusted together with organic matter could form PCDDs/DFs. Specifically, we incinerated newspapers with sodium chloride in a small-scale incinerator and measured PCDDs/DFs which formed during combustion. By examining the mass balance of inorganic ions, we detected a process triggering the formation of PCDDs/DFs via chloride radicals formed from sodium chloride. By analyzing low-chlorinated dioxins we also observed that the formation mechanisms of dibenzodioxins are different from those of dibenzofurans.

Research Center for Material Cycles and Waste Management

Targets and Outline

The current economic and social system –the so-called mass production, mass consumption, mass disposal society– is being steered toward a “Material Cycles Oriented Economy and Society”. However, a precise map or compass for where the world is going and where it should arrive is not available yet. Under these 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 the new focus of 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 analyzing a wide range of information, innovative technologies, and monitoring techniques. The tools for research and policy that we will consider include the legal system, advance of high technologies, economic

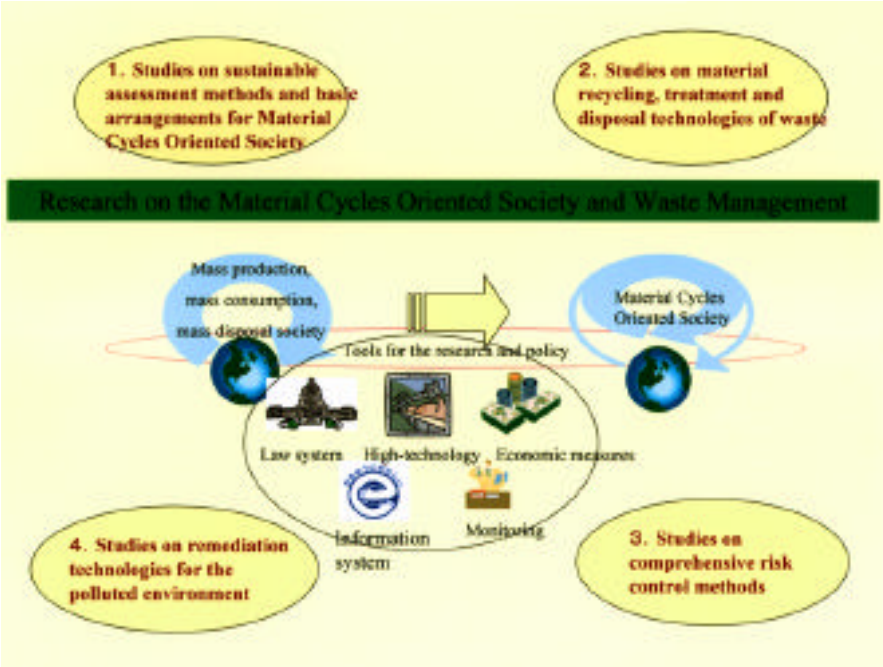


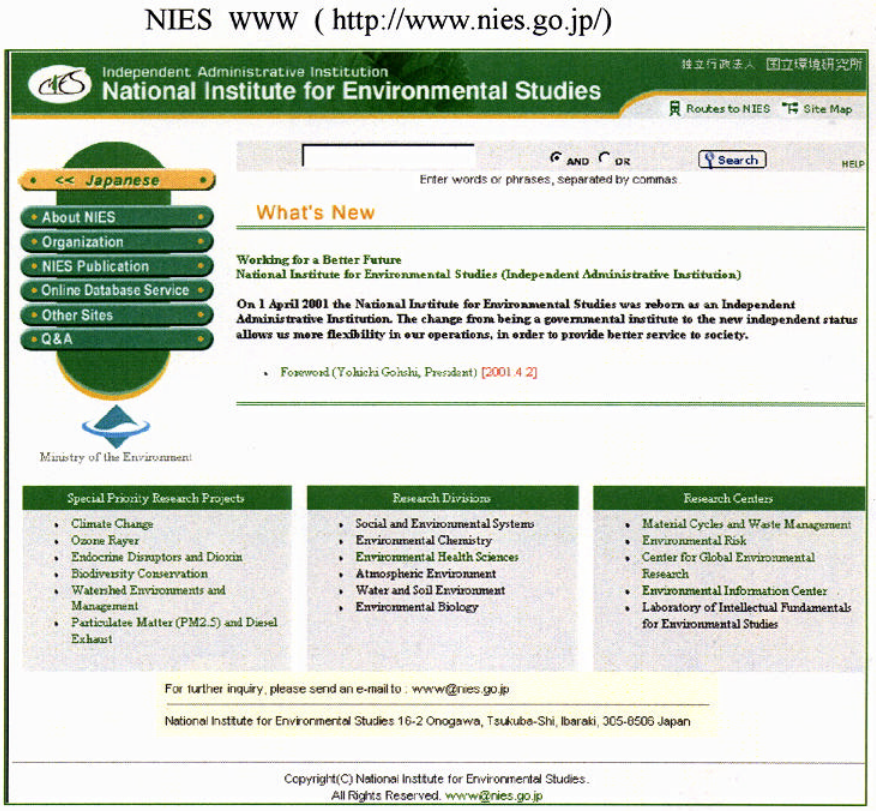
Fig. 1
Research Topics in the Research Center for Material Cycles and Waste Management.

measures, information systems, and monitoring techniques (Fig. 1).

The 4 main topics we will tackle are as follows: 1) assessment methods of sustainable society and the basic systems arrangement for a Material Cycles Oriented Society, 2) material recycling, treatment, and disposal technologies, 3) comprehensive risk control methods related to material cycles, and 4) remediation technologies for polluted environments. We will focus on research concerning assessment methods of sustainable society and the preparation of basic systems for supporting the conversion to a Material Cycles Oriented Society. Many issues concerning waste –from waste prevention to recycling, treatment, and disposal of wastes– are our targets of research. To achieve these targets, we will carry out research ranging from basic studies of waste characterization, hazardous substance characterization, and risk management, toward practical studies of technological control methods and system development and assessment.

Environmental Information Center

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



http://www.nies.go.jp/joho/index-e.html

http://www.nies.go.jp/english/eic-e/eig01.html

The Environmental Information Center is responsible for various functions and services related to the collection and provision of environmental information. We operate and maintain databases, a library, and a computer system, enabling the handling of a wide range of environmental information.

Database Section

Processing and Provision of Environmental Information Databases

1) Monitoring data files

Many types of numerical environmental data are needed for environmental research as well as for environmental policy development, implementation, and enforcement. The Center has compiled, processed, stored, and provided access to (in computer-accessible form) data files of air quality and water quality monitoring data, which are transmitted by local governments to the Environment Agency under the Air Pollution Control Law and the Water Pollution Control Law. These data files are provided to outside users including other governmental organizations and laboratories. A duplication service for use by the public is also available for some files. In addition, data files are exchanged with other governmental organizations.

2) Natural environment

Development of a General Reference System for the Natural Environment began in FY 1991 with the aim of providing basic reference materials that facilitate both understanding present conditions and forecasting changes in the natural environment. A database system (GREEN) using a UNIX database server is available on NIESNET to enable searches for and display of environmental data from all over Japan. Since FY 1995, we have been developing a system to provide database access by personal computers (PGREEN), based on previously recorded results and data.

3) Environmental information sources

Surveys of environmental information have been in progress since FY 1992 with the goal of providing a directory of information sources in a form widely accessible to the public. The surveys, including information about where and in what mode environmental information is being accumulated (environmental information sources) as well as explanations of laws, treaties and terms concerning the environment, are being provided to the public. We call this database the “EI-Guide”.

NIES-WWW

In March 1996, NIES began to provide environmental information on NIES research activities and results (in English and in Japanese) to the world via the Internet (http://www.nies.go.jp/). In April 2001, NIES-WWW was improved to enable the public to access NIES information more easily.

EICnet

In March 1996, the Center established the “Environmental Information & Communication Network” (EICnet) in accordance with the Basic Environment Law, to promote national activities for conservation of the environment. In April 2001, EICnet was modified and made available through an environmental Internet portal site. This system is currently available only in Japanese via the Internet (http://www.eic.or.jp/).

Library and Research Information Section

Compilation of Documentary Information on Environmental Research

Documentary information concerning the environment is essential for competent environmental research and management. We have created database systems containing informative documents about the environment to meet such needs. In addition, we have provided Institute users with access to other Japanese and foreign commercial databases.

Commercial databases available off-line on CD-ROM or diskette in the Institute include NTIS, Ei Energy and Environment, and Current Contents on Diskette. MEDLINE is available on-line from the ERL Internet Service. Access is also provided to several other on-line databases: JOIS, DIALOG, STN-International, G-Search and the British Library inside web.

Library Management and Operations

As of March 2001, the NIES library held 41 905 books, 583 technical and scientific serials, 8501 maps, 113 608 microfiches, and various other reports and reference materials. Library facilities include separate reading rooms for books, for journals, for indexes and abstracts, for reports, and for maps and microfiches, as well as a database access room and a photocopying room.

Editing/Publication

Reports concerning NIES research activities and results, an official newsletter (NIES News, in Japanese), and other reference materials are published by the Center and distributed to many organizations.

Information Management Section

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 that at present number 178. The Center has been designated as one of the national focal points of Japan since 1975. Focal points provide a wide range of environmental information products and services, including directories of sources of information, query-response services, and access to Internet services.

In September 2000, a global conference on reform of INFOTERRA was held in Dublin. There the following were agreed: 1) renaming of INFOTERRA to UNEP-Infoterra; 2) full support of each country to the environmental Internet portal development by UNEP; 3) establishment of a national consortium (network) in each country consisting of environment-related organizations, NGOs, etc.; and 4) cooperation between UNEP-Infoterra and the Aarhus Convention. In February 2001, this reform of INFOTERRA was reported at the UNEP Governing Council 21st Session and the global environmental portal site (UNEP.Net) was launched.

Management and Operation of Computers and Related Systems

A new computer system started operation in March 1997. 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 uses. This UNIX-based computing environment consists of a comparatively large-scale supercomputer system (NEC SX-4/32 [32 CPU]) and various subsystems such as a scalar-computing server (IBM RS6000/SP2 [16 CPU]), database servers (3 sets of SUN Enterprise 2/1200 [Oracle7, SAS] and 2 sets of NEC Express 5800/160 Pro [Oracle7 Workgroup]), and file servers (a DEC Alpha Server 8400 5/440 [4 CPU], 2 sets of Alpha Server 4100 5/400, a SONY File Bank system, and a Peta Site system).

Our SX-4/32 vector-computing system, including a front-end system (SX-4/4C [4 CPU]), employs the SUPER-UX (UNIX-based) operating system. The system is equipped with a FORTRAN compiler (with high-level debugging, high-efficiency optimization) and executes large-scale programs to handle global environmental problems. It is also equipped with an image processor and a 3-dimensional graphics processor (SGI Onyx MIPS R10000/R4400 [2 CPU]).

A LAN, called the NIES Network (NIESNET), was established at the Institute in 1992. File transport in various computer systems, as well as the IP Switch and IP Switch Gateway, were upgraded in March 1997; the network configuration was restructured and large-scale file transport performance was improved at that time. All Institute researchers can access the computer system from their own desk through the LAN. Foreign as well as Japanese registered users outside the Institute have remote access to the supercomputer system through NIESNET's connection to the Internet via the Inter-Ministry Network (IMnet).

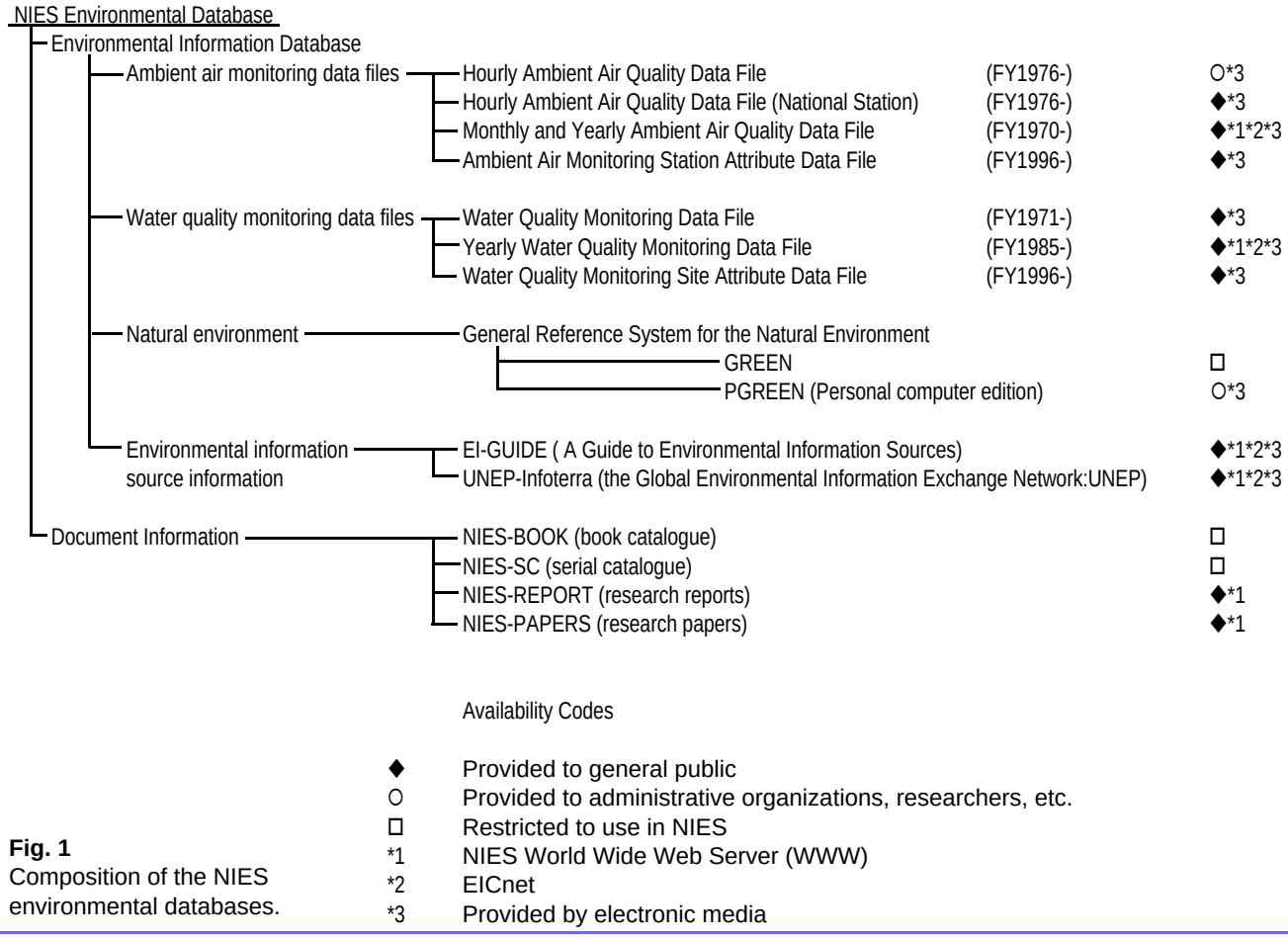
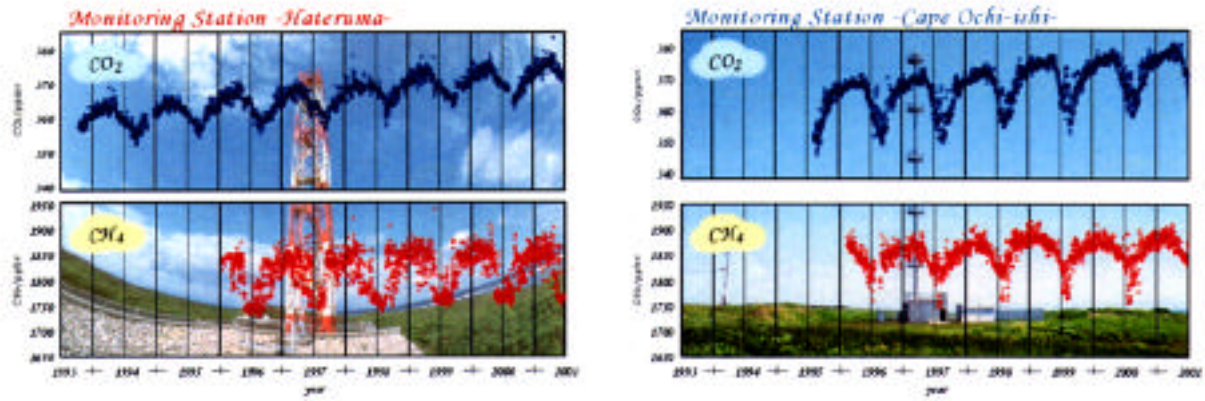


Fig. 1
Composition of the NIES environmental databases.

Center for Global Environmental Research



Figs. CO_2 and CH_4 concentration change in time at Hateruma and Cape Ochi-ishi

Center for Global Environmental Research (CGER) was established in October 1990 to contribute broadly to the scientific understanding of global change and to the elucidation of and solutions for our pressing environmental problems. CGER has 3 major activities: integration of global environmental research, management of a global environmental database, and global environmental monitoring.

Integration of global environmental research

Our objectives in integrating research are as follows: 1) to ensure communication and networking among researchers and decision-makers; 2) to cooperate with the Research and Information Office of the Global Environment Department of the Environment Agency of Japan in coordinating scientific and socio-economic research on global change; 3) to cooperate in international efforts to establish a research network for global change; 4) to promote model research using our supercomputer facilities, which are open to researchers at institutes and universities around the world; and 5) to conduct integrated research into policy options for coping with global environmental problems.

Enhancement of communication

CGER hosted several seminars, symposia, and conferences on research into global environmental change in FY 2000. As are listed in Table 1, CGER also supported groups seeking to organize workshops or symposia on specific research programs. These included: “IDGEC Carbon Management Flagship Research Activity Planning Workshop” (May 2000); “Recent Researches on Environmental Biology and Biodiversity of Terrestrial Cryptogamic Plants–Ecological and Taxonomical Points of View” (August 2000); “International Workshop for Advanced Flux Network and Flux Evaluation” (September 2000); “Joint Forum: Taxonomy Initiatives for Biodiversity Conservation in an IT Era” (January 2001); and “Workshop on GHG Emissions from Rice Fields in Asia” (February 2001).

Cooperation to promote and coordinate global change research

With the cooperation of the Research and Information Office, Environment Agency of Japan, CGER actively serves as secretariat for the Scientist Network on Indonesian Forest Fire (SNIFF). In FY 2000, CGER collected information on biodiversity as the regional center of Species 2000 Asia Oceania, and managed BIOS (Bacteriology

Table 1 Recent “Global Environment Tsukuba” conferences

Topic	Date	Place	Participants
Biodiversity and its Information	July 1999	Tsukuba	133 (69)
Indonesian Forest Fire	Mar. 2000	Tokyo	68 (15)
Integration and Regional Researches to Combat Desertification	Dec. 2000	Tsukuba	103 (29)
Marine Pollution by Persistent Organic Pollutants (POPs)	Feb. 2001	Tsukuba	56 (14)

*Figures in parentheses show number of participants from overseas.

Insight Orienting System), a database on bacteria and archaea. CGER has been participating in the work of the Intergovernmental Panel on Climate Change (IPCC), which approved its Third Assessment Report in March 2001. CGER also contributed to several international activities, such as the Interim Steering Committee for Global Biodiversity Information (GBIF); the Thematic Programme Network 1 (TPN1), which is a regional program of the Convention to Combat Desertification (CCD); the Acid Deposition Monitoring Network in East Asia (EANET); and the Working Group on Global Environmental Monitoring.

Coordinating supercomputer-aided research programs

CGER upgraded its supercomputer system to an NEC SX-4/32 in March 1997, and added ultra-high speed functions and large magnetic disks in March 1999, which have greatly improved the system's performance and facilitated research on global change. CGER published its annual "Supercomputer Activity Report" and "Supercomputer Monograph Report" and convened the "8th Supercomputer Research Workshop" to disseminate the latest knowledge obtained by users of the supercomputer. In FY 2000, CGER provided authorization for supercomputer system usage to 22 research programs. Among them, the main research themes were Predictions of Global Climate by NIES and MRI; their results are reported in the IPCC Assessment Report 2001.

Integrated research on policy options

Integrated Research, a special research category in the Environment Agency's Global Environment Research Program, is directed towards actual decision-making processes, through the development of conceptual models and the generation of data used widely in interdisciplinary research. Two research projects in this category were implemented in 2000: "Studies on Integrated Environmental-Economic Analysis toward a Sustainable Global Society" and "Studies on Methodology for Establishing a Greenhouse Gas Inventory System".

Management of the global environmental database

CGER is establishing a global environmental database system as well as producing and distributing UNEP/GRID environmental datasets to support environmental research and administrative decision-making.

During FY 2000, we focused on constructing a database of greenhouse gas sinks. We have been collecting satellite data and modeling sink activities since 1999. We organized the initial planning meeting for the Carbon Management Research Activity, (CMRA) together with the International Human Dimensions Programme on Global Environmental Change (IHDP). CMRA is one of the 3 major Projects of Institutional Dimensions of Global Environmental Change (IDGEC).

Regarding the original database, we continued work on our database of mitigation measures for climate change (the original database of individual fields) and updated the IPCC scenario database of greenhouse gas emissions for predicting the future environment in the Asian region. We used remote sensing to measure the amount of greenhouse gases removed by sinks such as forests and forest soils. We published a

report on the international trends in projects concerning greenhouse gas sinks that were discussed at COP6.

We also updated the inventory of the 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. To grasp land use change in East Asia from the past to the present, we continued making mosaic land use maps for 500 km square North Korea (circa 1980). We also continued to collecting terrestrial ecosystem data from sites in Malaysia and Sri Lanka to grasp the present conditions and changes in tropical forests.

GRID

The Global Resource Information Database (GRID) was established in 1985 within UNEP to provide timely and usable 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. During FY 2000, 104 datasets were distributed to users in and outside of Japan in response to 18 requests. We updated 0.5˚ grid data on world solar radiation in a database for studies on greenhouse gas sinks. We reported GRID-Tsukuba's activity at the First collaborative Assessment Network Meeting, held in Thailand on 25 and 26 October.

Global Environmental Monitoring

CGER has observed and recorded data on various global phenomena via long-term monitoring programs. These data are available through published data reports or dataset files provided by the international networks in which CGER participates. The following 12 projects are presently coordinated by CGER.

Ozone monitoring with ozone lidar (laser radar) and millimeter-wave ozone radiometer

CGER measures the vertical profile of ozone in the lower stratosphere over Tsukuba with an ozone lidar that was installed in August 1988. Monitoring of the ozone layer commenced in October 1990. In FY 1996, the ozone lidar system was modified to extend the ozone measurements to range from 10 to 45 km. Millimeter-wave measurements ranging from 35 to 75 km started in October 1995. Since then, we have determined vertical ozone profiles through the whole stratosphere. We analyze the millimeter-wave measurements to clarify temporal variations in ozone levels.

Monitoring network for ultraviolet-B radiation

In 1999, CGER started a nationwide ultraviolet monitoring network at 20 sites in collaboration with several universities and institutions to identify the trends in ultraviolet-B radiation (UV-B) at the ground surface resulting from stratospheric ozone layer depletion, and to evaluate the effect of UV-B on human health.

Stratospheric monitoring in northern Japan

To monitor the stratospheric ozone layer over the northern part of Japan, the Rikubetsu Station for the Detection of Stratospheric Change was established in Hokkaido in October 1997. NIES has cooperated with the Solar-Terrestrial Environment Laboratory

of Nagoya University in monitoring ozone and related species. In March 1999, we installed a millimeter-wave radiometer, which measures ozone levels hourly at heights of 20 to 60 km; in May 1999, we installed a Brewer Spectrophotometer, which measures UV-B and total column ozone.

Ground-based monitoring of greenhouse gases (Hateruma Island and Cape Ochi-ishi)

We continuously monitor the concentrations of greenhouse gases (GHGs) at these 2 stations to understand trends in the background air quality in Japan. Atmospheric data from the monitoring station on Hateruma, the southernmost inhabited island in Japan, is expected to be representative of the air quality in southern Japan. Monitoring there started in October 1993. We have collected similar data for northern Japan at the station in Cape Ochi-ishi, Hokkaido, since September 1995; in 1999, this station joined the Acid Rain Monitoring Network in East Asia as a rural site.

Monitoring of greenhouse gases over Siberia by aircraft

The boreal forest CO_2 sink and CH_4 emissions are among the factors that govern variations in the carbon cycle in the northern hemisphere. Vertical concentration profiles of GHGs from 500 to 7000 m in several areas of Siberia are obtained monthly by sampling from aircraft, followed by laboratory analysis in NIES. We have been carrying out monitoring over Surgut (lat 60˚N) in central western Siberia since 1993, over Yakutsk (lat 60˚N) in eastern Siberia since 1996, and over Novosibirsk (lat 55˚N) in southwestern Siberia since 1997. The seasonal amplitude of CO_2 variations over Siberia appears to be larger than that measured over the sea at the same latitude.

Monitoring of greenhouse gases along a north-south transect in the western Pacific by ships-of-opportunity

Routine sampling of background air along a north-south transect became possible by using a cargo ship sailing regularly between Japan and Australia 8 times a year. Additional sampling at higher latitudes started in 1995 by utilizing a cargo ship sailing regularly between Canada and Japan. Samples are collected and sent to CGER after every voyage for high-precision determination of GHGs such as CO_2, CH_4, and N_2O. The data are useful for studies on global cycles of GHGs.

Monitoring of atmosphere-ocean carbon dioxide exchange by a ship-of-opportunity

Influx of CO_2 from the atmosphere to the ocean constitutes one of the most important sinks in global carbon cycling. To estimate the net rate of atmosphere-ocean CO_2 exchange we installed instruments on a cargo ship sailing between Canada and Japan to automatically measure the partial pressure of CO_2 in the air and surface of the ocean. In the northern sub-arctic Pacific, there is clear influx of CO_2 into the ocean in summer and outflow of CO_2 from the ocean to the atmosphere in winter. In the mid-latitude Pacific, the ocean behaves as a CO_2 sink throughout the year.

Monitoring the flux of greenhouse gases in a northern forest

In 2000, CGER, in cooperation with the Hokkaido Regional Forestry Office, started

measuring CO_2 flux in woodland ecosystems as a global environmental monitoring activity. The site is in a larch (Larix) forest located in the Tomakomai National Forest, Hokkaido. The project aims to measure fluxes of CO_2 and energy according to internationally standardized techniques, provide continuous measurements of various functions of the ecosystem, and play a role in the AsiaFlux Network as a core site for development and examination of observation systems in Japan and Asia.

High temporal-spatial resolution biogeochemical monitoring of the western Pacific by ships-of-opportunity

The cycles of chemical elements such as C, N, P, and Si have changed from those in pre-industrial and pre-agricultural times. These changes are thought to have an impact on the ocean through marginal seas. CGER has been measuring temperature, salinity, pH, fluorescence, dissolved nutrients, chlorophyll-*a*, and pheopigments in the continuous water intake of vessels sailing between Osaka and Beppu.

Mapping the vegetation index with NOAA satellite data

To monitor changes in vegetation and land cover in East Asia, Normalized Difference Vegetation Index (NDVI) mosaic images are composed from Advanced Very High Resolution Radiometer (AVHRR) data from NOAA satellites. In FY 2000, monthly NDVI mosaic images from January to December 1999 were produced from AVHRR data received by the 2 receiving stations at Tsukuba in Ibaraki Prefecture and Kuroshima in Okinawa Prefecture. We estimated Net Primary Production (NPP) values of vegetation by integrating monthly NDVI values over a year.

ILAS-II data-handling facility

ILAS-II is a satellite sensor that will be launched in 2002. The ILAS-II data-handling facility (DHF) houses a computer system to process ILAS-II data to retrieve atmospheric gas profiles in the polar stratospheric ozone layer. The ILAS-II DHF has also re-processed a set of data measured by ILAS, which operated for about 8 months from November 1996 to June 1997. The resulting data products have been used for atmospheric scientific research and provided to general users via the Internet. In FY 2000, we carried out system performance tests and updates of the ILAS-II DHF. Also in FY 2000, we installed a new computer system in a room at the ILAS-II DHF to research data retrieval algorithms for SOFIS, the successor of ILAS-II. Management of the ILAS-II DHF is the responsibility of CGER in cooperation with the Satellite Remote Sensing Research Team.

GEMS/Water Program

GEMS/Water is the Global Environmental Monitoring System for rivers and lakes, organized under UNEP and WHO. A network of 23 stations in Japan has been established for GEMS/Water Phase II activities. Lakes Mashu and Kasumigaura have been registered as network sites. CGER is responsible for coordinating GEMS/Water data transmissions, etc., as the Japanese National Center (focal point). CGER also participates in an Analytical Quality Control (AQC) Program.

Environmental Training Institute

Since its foundation in 1973, the National Environmental Training Institute (NETI) has provided governmental staff with training courses on administrative skills and analytical techniques in the environmental field. A total of 30,989 individuals from governmental and other organizations had completed their training at NETI by the end of March 2001 (Table 1). Among them, 74% were from local governments, 20% from the central government, and the remainder from public corporations (Fig. 1). NETI also accepts trainees from overseas.

In FY 2000, we provided 19 courses on administration, 13 on laboratory analysis, and 7 on international cooperation (Table 2). There were several new courses. One of them was the Global Warming Control course that shows the “best practices” carried out inside and outside Japan that are contributing to the mitigation of global warming. The course also introduces a procedure for drafting an action plan that, as stipulated by law, local governments and the central government must now draw up. Because the hazards of dioxins and endocrine disrupters have become widely recognized throughout the country, this year we added several courses for analyzing dioxins to ensure that local governments are properly equipped with technical officials. Also,

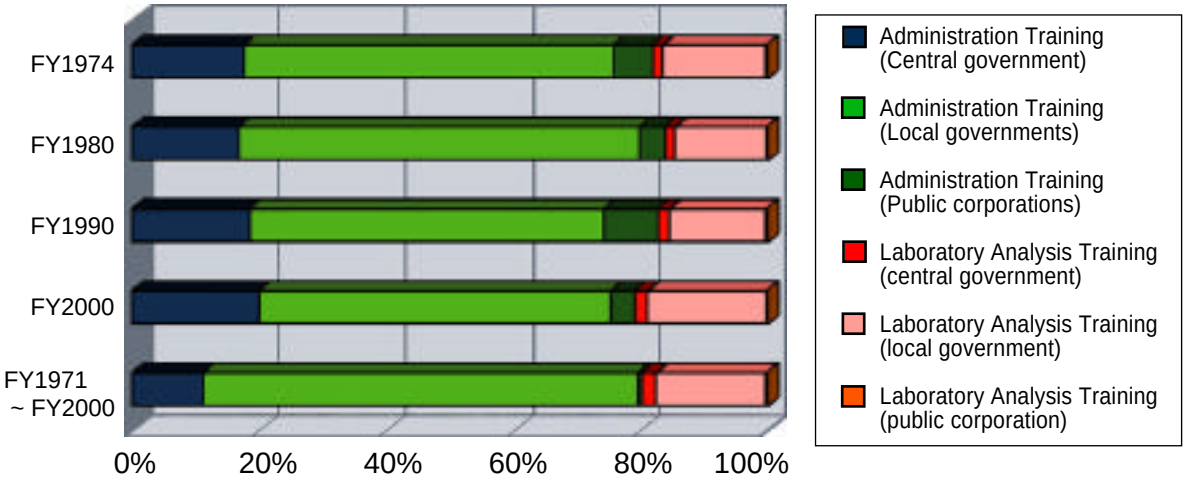


Fig. 1
Percentages of the participants from the central, local governments and public corporations in administration training courses and laboratory analysis training courses.

Table 1

FY	Central government	Local government	Public Corporations	Total
1975	143	745	9	897
80	208	692	39	939
85	186	672	66	924
90	230	804	103	1,137
95	242	926	101	1,269
96	234	860	114	1,208
97	250	925	103	1,278
98	252	974	48	1,274
99	261	911	46	1,218
2000	255	1,068	57	1,380
Total (1971-2000)	6,044	22,992	1,953	30,989

Table 2 (FY 2000)

Administration Training Course

Course name	Length (days)	Number of Participants
Environmental policy	4	56
Regional environmental management and the Basic Environment Plan	5	83
Environmental education	5	76
Environmental impact assessment	8	104
Nature conservation	5	66
Wildlife conservation	5	42
Air pollution control	5	105
Noise and vibration control	5	74
Water pollution control	5	103
Environmental conservation of ground, soil and ground water	5	54
Environmental information management	5	19
Hazardous chemical substance control	5	60
Environmental administration for supervisor	3	39
Staff of Ministry of the Environment (sub-section chiefs)	5	8
New recruits of Ministry of the Environment (class I)	7	19
New recruits of Ministry of the Environment (class II & III)	5	20
Newly assigned staff of regional environmental information office	4	10
Nature conservation for National Park Ranger	5	38
Environmental policy research and formulation	62	1
Sub Total	—	977

Laboratory Analysis Training Course

Course Name	Length (days)	Number of Participants
Instrumental analysis	10	41
Air quality analysis	12	22
Water quality analysis	12	38
Offensive odor analysis	5	11
Special instrumental analysis I (twice)	5	20
Special instrumental analysis II (twice)	5	19
Special Topics		
Periphytic algae	5	6
Plankton	5	12
Macrobenthic invertebrate	5	13
Environmental monitoring for dioxins (basic course) (3 times)	22	30
Environmental monitoring for dioxins (advanced course)		
Air and exhaust gas course	18	6
Water quality and ground soil course	18	4
Special analysis	20	1
Sub Total	—	223

International Cooperation Training Course

Course Name	Length (days)	Number of Participants
Global environmental conservation	5	40
Global warming control	7	70
Trainers for overseas trainees	5	4
Expert development for international environmental cooperation (step 1)	5	44
Expert development for international environmental cooperation (step 2)	10	14
Expert development for international environmental cooperation (step 3)		
Environmental administration and planning	20	5
Environmental analysis and monitoring	20	3
Sub Total	—	180

International Technical Cooperation Training Course

Course Name	Length (days)	Number of Participants
Environmental Monitoring (Water Quality) <JICA>	32	12
Grand Total	—	1,392

following the legislation of the pollutant release and transfer register (PRTR), we introduced the Chemical Substance Control course; this course explains the hazardous characteristics and risks of chemical substances, how to respond to anxieties of citizens from the side of law enforcement, and particularly, the role of local governments. Another course worth noting here was the Environmental Administration for Supervisors course, designed for high-ranking officials in positions of environmental administration in central and local governments to learn the priorities and trends in environmental administration in the new century, through lectures and exchange of opinion among participants.

In FY 2001, NETI is introducing 4 new courses on wastes and recycling. Lately, various waste-related problems, such as disputes over locations of landfill, illegal waste dumping, pollution of the environment by dioxins, etc., have been mounting throughout the country. In response to these problems, the Basic Law for Establishing a Recycling-Based Society and other related laws have been enacted. However, there are far from sufficient administrative personnel to enforce these laws, and quite high expectations that local governments should appropriately manage waste disposal and recycling. For this reason, NETI is committed to providing training courses that aim to develop personnel able to draw up policy plans in their respective prefectures, cities, etc. As for techniques to detect and monitor dioxins, NETI is adding yet another analysis course for dioxins and is now building a second facility for conducting training in dioxin analysis.

NETI is going to be transferred from NIES to the General Environmental Policy Bureau of the Ministry of the Environment in April 2001, as a part of structural reform of the former Environment Agency. As before, NETI continues to be committed to offering training courses that meet the new demands for environmental training courses, as new legislation is enacted or changed and the focus of environmental administration shifts.

<Global Environment Research Projects>

Ocean biological processes related to uptake of CO_2 in the North pacific, Mukai, H., 1999-2000

Factors influencing the future ozone layer, Imamura, T., 1999-2001

Development of matrix for air pollutants emission and deposition and international cooperative field survey in East Asia, Hatakeyama, S., 1999-2001

Environmental load through Chang Jiang River catchment and its effect on marine ecosystem in East China Sea, Watanabe, M., 1999-2001

Optimizating the sustainable management of tropical forests, Okuda, T., 1999-2001

Satellite remote sensing, Sasano, Y., 1989-2002

Special collaborative studies for the assessment of integrated sustainable development policies to mitigate climate change based on AIM (Asia-Pacific Integrated Model), Kainuma, M., 2000-2002

Studies on the development of monitoring and evaluation technology for the global-scale marine pollution with hazardous chemicals, Kunugi, M., 2000-2002

<Special Research Projects>

Chemical behavior of hazardous substances from waste landfill, Yasuhara, A., 1998-2000

Development of comprehensive toxicity testings for the assessment of total risk from environmental chemicals, Kunimoto, M., 1998-2000

VOCs distribution and its effects on urban air quality, Wakamatsu, S., 1998-2000

Experimental study on damaging-mechanism on cardiovascular system of suspended five particulate matters (PM2.5), Takano, H., 1999-2001

Exposure and health effects assessment of dioxins, Yonemoto, J., 2000-2002

Quantitative analysis on prospect to sustainable recycle based society focussing on wastes management, Masui, T., 2000-2001

Development of new measurement method of Dioxins, Ito, H., 2000-2002

<International Joint Research Projects>

Development and application of environmental analysis and evaluation methods for atmospheric aerosols in China, Nishikawa, M., 1996-2000

International collaborative research on environmental management of watershed, Watanabe, Masataka; 1996-2000

International cooperative research on health effects of urban air pollution and its preventive measures in China, Tamura, K., 2000-2004

<Others>

Comprehensive studies on the endocrine disrupting compounds (EDC) in the environment, Morita, M., 1999-2003

International Workshop for Advanced Flux Network and Flux Evaluation

September 27-29, 2000
Hokkaido University,
Sapporo, Japan

The International Workshop for Advanced Flux Network and Flux Evaluation was held with goal of improving measurement methods, establishing a network in Asia and enhancing communication among researchers and laboratories in the world. About 120 flux researchers from Japan and abroad attended. Twenty researchers came from 11 countries including the US, Europe, China, Russia, Korea, Thailand and others. Researchers discussed the important subjects of the methodology of flux measurement, and exchanged results, data and knowledge. They also compared results from each site to improve the accuracy of measurement methods. Further, they discussed prospects for international collaboration in order to establish a flux measurement network in Asia.

The 8th Japan-U.S. Workshop on Global Change

—Health and the Environment

November 13-15, 2000
Natcher Center
National Institute of Health
Bethesda, Maryland

This workshop was the eighth in a series of Japan-U.S. Workshops on Global Change Research held under the framework of the Japan-U. S. Agreement on Cooperation in Research and Development in Science and Technology. The workshop focused on the topic of Health and the Environment: Climate Change and Health Effects of Exposure to Higher Temparatures, Air Pollutant Concentrations and Ultraviolet Radiation. 65 individuals participated in the workshop, including sicentists, science managers from governments, hospitals, and national institute of Japan and United States. Many major recommendations for collaboration in areas in which Japanese and American scientists can work together to address many of the difficult questions affecting the global climate have been identified.

16th Global Environment Tsukuba 2000

International Symposium: Integration and Regional Researches to Combat Desertificaion —Present State and Future Prospect—

December 7-8, 2000
NIES,
Tsukuba, Japan

Affecting more than one forth of the total land areas of the world, desertification is one of the most serious global environmental problems in the world and is closely related to both the natural environmental and the socioeconomic conditions in each affected area. To combat desertification, we need to develop appropriate strategies urgently. In this workshop, we compared and examined the present state of desertification research and countermeasures around the world in order to clarify the regional and global characteristics of the desertification problem and also to discuss the direction of desertification research. Researchers from Japan, China, Mongolia, Sub-Saharan Africa, Western Australia and other regions reported their own knowledge and information on desertification. More than one hundred researchers participated in this symposium, and 28 oral presentations and 20 poster presentations were made in two days.

17th Global Environment Tsukuba '01

—International Workshop on Marine Pollution by Persistent Organic Pollutants (POPs)

February 26-27, 2001
NIES,
Tsukuba, Japan

The primary purpose of this workshop is to summarize information on the current status of, and to promote communication and encourage cooperation among major research activities on the marine pollution by persistent organic pollutants (POPs). POPs are a group of chemicals characterized by their properties of persistence, long-range transport, high bioaccumulation factors, and toxicities/ adverse effects to wildlife as well as human beings. Due to their persistence and transportability, international cooperation is indispensable for tackling with POPs. In this workshop, present status of POPs pollution was summarized by the several reports on their concentration as well as adverse effects, and then both monitoring and model research were reported on their environmental cycling and fate. About 60 researchers from Japan and abroad (US, UK, Canada, etc.) participated in this workshop, and 15 oral presentations and 11 poster presentations were made.

Japan/US International Workshop on Endocrine Disrupting Chemicals and Their Toxicological Evaluation

February 28-March 3, 2001
NIES,
Tsukuba, Japan

Under the Japan-US Environmental Protection Agreement as well as Japan-US Science and Technology Cooperation Agreement, NIES held this workshop suppoted by JISTEC/STA. The worshop aimed to exchange latest scientific research contents in both countries regarding EDC effects especially focused on the aspect of reproductivity. 124 reseachers and administrators including 20 scientists in US participated in this workshop, and 6 research statements which direct future cooperation between Japan and US was adopted.

COUNTRY
No.Title
Collaborating Institution
NIES Partner

AUSTRALIA
1. Biogeochemical studies on the trace elements in marine environments
Western Australian Marine Research Lab.
Environmental Chemistry Div.
2. Development of new methodologies to assess physiological effects of environmental pollutants
Dept. Biochemistry, Univ. Tasmania
Environmental Health Sciences Div.
3. Cooperative research on global environmental monitoring
CSIRO
Atmospheric Environment Div.
4. A comprehensive database of microbial diversity: cyanobacteria
University of NSW
Environmental Biology Div.
5. 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.
5. Development of assessment and testing method for endocrine disrupting chemicals
Division of Environmental Risk Assessment, National Institute of Environmental Research
Regional Environment 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.

FINLAND
1. Accumulation of heavy metals by bryophytes in acidic environments
Dept. Botany, Helsinki Univ.
Global 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.
8. Study on measurement of atmospheric trace species using FTIR and other methods in Siberia
Institute of Solar-Terrestrial Physics, RAS
Atmospheric Environment Div.

GERMANY
1. Monitoring of stratospheric ozone by laser radar
Hohenpeissenberg Meteological Observatory
Global Environment Div.
2. Observational studies of the arctic ozone layer using satellite, airborne and other sensors
Div. Climate and Atmospheric Research, BMFT
Global Environment Div.
3. Comparative study on total material flow balance between Japan and Germany
Wuppertal Institute for Climate, Environment and Energy
Regional Environment Div.
4. Evaluation method of environmental burden
Federal Environmental Agency
Social Environmental Systems Div.
5. Research on the changing composition of the atmosphere
Univ. Bayreuth
Atmospheric Environment Div.
6. Studies on eutrophication and related problems in closed water bodies
Nuclear Research Center, Karlsruhe
Water and Soil Environment Div.
7. Satellite measurement of atmospheric gases (ADEOS project)
Alfred Wegener Institute
Global Environment Div.

ISRAEL
1. Novel applications of supersonic free jet for environmental measurement
Sch. Chemistry, Tel Aviv Univ.
Environmental Chemistry Div.

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
Global Environment Div.
2. A joint-study on health effects of high-tech-related materials
Gyeong-Sang Natl. University
Regional Environment Div.
3. Cross-cultural comparison of landscape evaluation between Japanese and Korean
KyungPook University
Social and Environmental Systems Div.
4. Organotin pollution and “imposex” in sea snails in Korea
Yosu National University
Regional Environment Div.
5. Study on the monitoring of harmful algal bloom and effects of nitrogen and phosphorus
National Institute of Environmental Research
Regional Environment Div.
6. 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.
7. Study on the marine pollution using ship-of-opportunity
Korea Ocean Research and Development Institute
Global Environment Div.
8. Study on the long range transport of POPs by using ship-of opportunity
Korea Ocean Research and Development Institute
Global Environment 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
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 Environmental Research

6. Research Programs under the Baikal International Center for Ecological Research (BICER)
   Limnological Institute, RAS
   Environmental Chemistry Div.
7. Vertical profile measurement of greenhouse gases over Siberia
   Institute of Atmospheric Optics
   Center for Global Environmental Research
8. Collaborative research on management of wetland ecosystems
   Institute of Biology & Soil Sciences
   Environmental Biology 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. Solubilization of toxic heavy metals from man-made objectives by acid rain
   Dept. Earth Science, Univ. Sheffield
   Regional Environment Div.
2. In vivo NMR spectroscopy method and its application to the field of environmental health
   Dept. Biochemistry, Univ. Cambridge
   Environmental Health Sciences Div.
3. Effects of environmental pollution on the metabolism of trace elements in man
   Rowett Research Institute
   Environmental Health Sciences Div.
4. Algae and Protozoa
   CCAP, Institute of Freshwater Ecology
   Environmental Biology Div.
5. Impacts of atmospheric change on crops and native species
   University of Newcastle
   Center for Global Environmental Research
6. Cooperation on the development and application of Coupled Chromatography-Accelerator Mass Spectrometry Techniques
   University of Oxford
   Environmental Chemistry Div.
7. Studies on intermediary species in atmosphere and frames
   Department of Chemistry, University of Wales Swansea
   Environmental Chemistry Div.
8. 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
   Environmental Chemistry Div.
9. Studies on molecular biology and ecology of methanotrophs
   University of Warwick, Department of Biological Sciences
   Water and Soil Environment Division
10. Analysis of observation of stratospheric ozone layer using three dimensional models
    Department of Chemistry, University of Cambridge
    Atmospheric Environment Div.
11. Studies on the bark pockets as pollution time capsules for monitoring of the environment
    University of Sheffield
    Global Environment Div.
12. Biodiversity and phylogeny of *coccolithophorids*
    Paleontology Department, The Natural History Museum
    Environmental Biology Div.
13. Mechanisms of phagocytic activities in alveolar macrophages
    Sir William Dunn School of Pathology University of Oxford
    Regional 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).
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 Subject (Host Researcher)

<Global Environment Division>

Hooper, Rowan Earle, U. K., 1997. 9. 1~2000. 11. 30
Individual variation of parasite resistance in Calopterigid damselflies (Tsubaki, Y.)

Hylander, Lars Daniel, SWEDEN, 2000. 10. 26~2000. 12. 24
Studies on the historical change of environmental pollution by using barkpockets (Satake, K.)

Klotz, Bjoern, GERMANY, 1999. 10. 15~
Atmospheric photooxidation reactions of aromatic hydrocarbons from motor vehicles. (Washida, N.)

Lefèvre, Franck, FRANCE, 2000. 12. 15~2001. 3. 31
Stratospheric denitrification and composition of polar stratospheric clouds inferred from 3D simulations and ILAS data (Nakajima, H.)

Oshchepkov, Sergei Leonidovitch, BELARUS, 2000. 5. 24~2001. 3. 31
A study on simultaneous retrieval of aerosol/non-gaseous components with gases from multi-spectral satellite measurements (Nakajima, H.)

Yang, Hong-Wei, CHINA, 2000. 1. 10~2000. 4. 9
Development of simulation model for Chinese energy system analysis (Kainuma, M.)

Yang, Hong-Wei, CHINA, 2000. 9. 21~2001. 3. 31
International collaborative studies for evaluating the effects of CDM (Clean Development Mechanism) (Kainuma, M.)

<Regional Environment Division>

Anuradha, D. Cunnigaipur, INDIA, 1998. 11. 2~2000. 11. 1
Gene expression in the lung following exposure to atmospheric pollutants (Hirano, S.)

Anuradha, D. Cunnigaipur, INDIA, 2000. 11. 2~2001. 2. 1
Apoptosis in fluoride-exposed cells (Hirano, S.)

Ding, Guoji, CHINA, 2000. 7. 14~2001. 3. 31
Development of advanced biological wastewater treatment system by effectively using useful protozoa and metazoa besed on ecological engineering (Inamori, Y.)

Guang, Jia, CHINA, 2000. 2. 1~2001. 3. 31
Mechanistic study of heavy metal-induced carcinogenesis (Sone, H.)

Gui, Ping, CHINA, 2000. 7. 1~2001. 3. 31
Development and generalization of key techniques on CH_4 and N_2O emission control in domestic and industrial wastewater treatment using bio-ecosystem (Inamori, Y.)

Jang, Min-Ho, KOREA, 2001. 1. 4~2001. 3. 3
Change of toxin production of cyanobacteria affected by predators, such as fish, zooplankton (Takamura, N.)

Kim, Baik-Ho, KOREA , 1998. 4. 16~2000. 4. 15
Relations between Aquatic Organism and Water Quality Shallow Lake Kasumigaura (Takamura, N.)

Kim, Jeong-Soon, KOREA, 1999. 11. 1~2001. 3. 31
Effect of Alcaligenes faecalis on Nitrous Oxide Emission and Nitrogen Removal in Municipal Wastewater Treatment. (Inamori, Y.)

Krishnalumar, Bhaskaran, INDIA, 2000. 10. 1~2001. 3. 31
Control of Biomass Production in Nutrient Removing Activated Sludge System by Increased Non growth Energy Dissipation (Inamori, Y.)

Kyong, Ha, KOREA, 1999. 11. 16~2000. 11. 3
Fundamental Studies on lakes and river for ecosystem managements: with the emphasis on interrelation ships (Takamura, N.)

Kyong, Ha, KOREA, 2001. 1. 4~2001. 3. 3
Morphologic changes of phytoplankton by the limitation of the nutrients supplying and grazing effects of predators (Takamura, N.)

Nam, Kwang-yun, KOREA, 1999. 12. 21~2000. 10. 24
Activated sludge modeling and it's application to conbined activated sludge and Alcaligenes Faecalis immobilization carrier process (Inamori, Y.)

Poonam, Sarkar, INDIA, 2000. 4. 1~2001. 3. 31
Effect of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin on aromatase activity in rats (Yonemoto, J.)

Preeti, Dass, INDIA, 2000. 8. 29~2001. 3. 31
Development and generalization of key techniques on CH_4 and N_2O emission control in domestic and industrial wastewater treatment using bio-ecosystem (Inamori, Y.)

Sun, Liwei, CHINA, 2001. 2. 1~2001. 3. 31
Establishment of the multiple-trophic level biological system in wastewater treatment to improve the quality of the effluents and minimize the biomass yields (Inamori, Y.)

Wui, Seong Uk, KOREA, 2000. 7. 31~2001. 2. 26
A study of the technology to improve water quality assessment using an ecosystem model (Inamori, Y.)

Wui, Seong Uk, KOREA, 2001. 2. 27~2001. 3. 31
Effect of pesticides to individual movement in the microcosm (Inamori, Y.)

Yufang, Yang, CHINA, 2000. 6. 19~2001. 3. 31
Development of effective treatment technology for sludge wastes from domestic wastewater and lake water purification system (Inamori, Y.)

<Social and Environmental Systems Division>

Ahish, Rana, INDIA, 2000. 5. 23~2001. 3. 31
Model assessment of macro-economic effect of environmental industries (Morita, T.)

Dolf, J. Gielen, NETHERLAND, 2000. 10. 1~2001. 3. 31
Accounting and modeling of energy and material flows (Moriguchi, Y.)

En, Wu, CHINA, 2000. 6. 15~2000. 7. 28
Development of sustainable method for tourism planning (Aoki, Y.)

Eric, W. Welch, U. S. A., 2000. 5. 15~2000. 7. 14
Effect of the pollution reduction agreement in the electric industry (Hibiki, A.)

Malik, Amin Aslam, PAKISTAN, 2000. 11. 26~2000. 12. 25
Sustainable technology transfer with in the context of the design of the clean development mechanism (Kawashima, Y.)

Pranab, Jyoti Baruah, INDIA, 2000. 6.19~2001. 3. 31
Water quality of Lake Kasumigaura using remote sensing (Tamura, M.)

Yang, Cuifen, CHINA, 2001. 3. 1~2001. 3. 31
Study on the land cover changes and its driving factors in the Lio River (Tamura, M.)
You, Songcai, CHINA, 2000. 4. 1~2001. 3. 31
Development of assessment model for climate change impact on agriculture in China (Morita, T.)

<Environmental Chemistry Division>

Alam, Mohammed Golam Mahbub, BANGLADESH, 1999. 8. 9~2001. 3. 31
Bioacumulation of heavy metal through food web system in Lake Kasumigaura (Tanaka, A.)
Chatterjee, Amit, INDIA, 1998. 6. 10~2000. 6. 9
Speciation and efficient removal of arsenic in the environment (Shibata, Y.)
Chowdhury, A.Z.M.Shaifullah, BANGLADESH, 1999. 10. 1~2001. 3. 31
Arsenic speciation in the environment: in context of Bangladesh (Shibata, Y.)
Guodong, Yuan, CANADA, 2000. 11. 13~2001. 1. 31
Surface Reactions of Heavy Metals with Clay Minerals and Natural Organic Matter (Seyama, H.)
Jian, Zheng, CHINA, 2001. 3. 1~2001. 3. 31
Development of hyphnated technique for multi-element speciation analysis and its application to biological, medical and environmental sciences (Shibata, Y.)
Kareev, Mikhail Sergeyevich, RUSSIA, 1998. 11. 25~2000. 11. 24
Detection of free radical species in plasma & atmospheric environment with use of Li+ion attachment techniques (Fujii, T.)
Lu, Ming, CHINA, 1999. 8~2000. 9. 30
Analytical Chemical Study on Effects of Endocrine Disruptors to Reproduction in Marine Organisms (Horiguchi, T.)
Panneer, Christopher Selvin, INDIA, 2000.5.15~
Computer chemistry for formation reaction & toxicity index of dioxins (Fujii, T.)
Radu, Gabliel Lucian, ROMANIA, 2001. 1. 15~2001. 3. 14
Effects of metal ions on growth of toxic cyanobacteria (Kaya, K.)
Sablier, Michel Claude, FRANCE, 2000. 8. 1~
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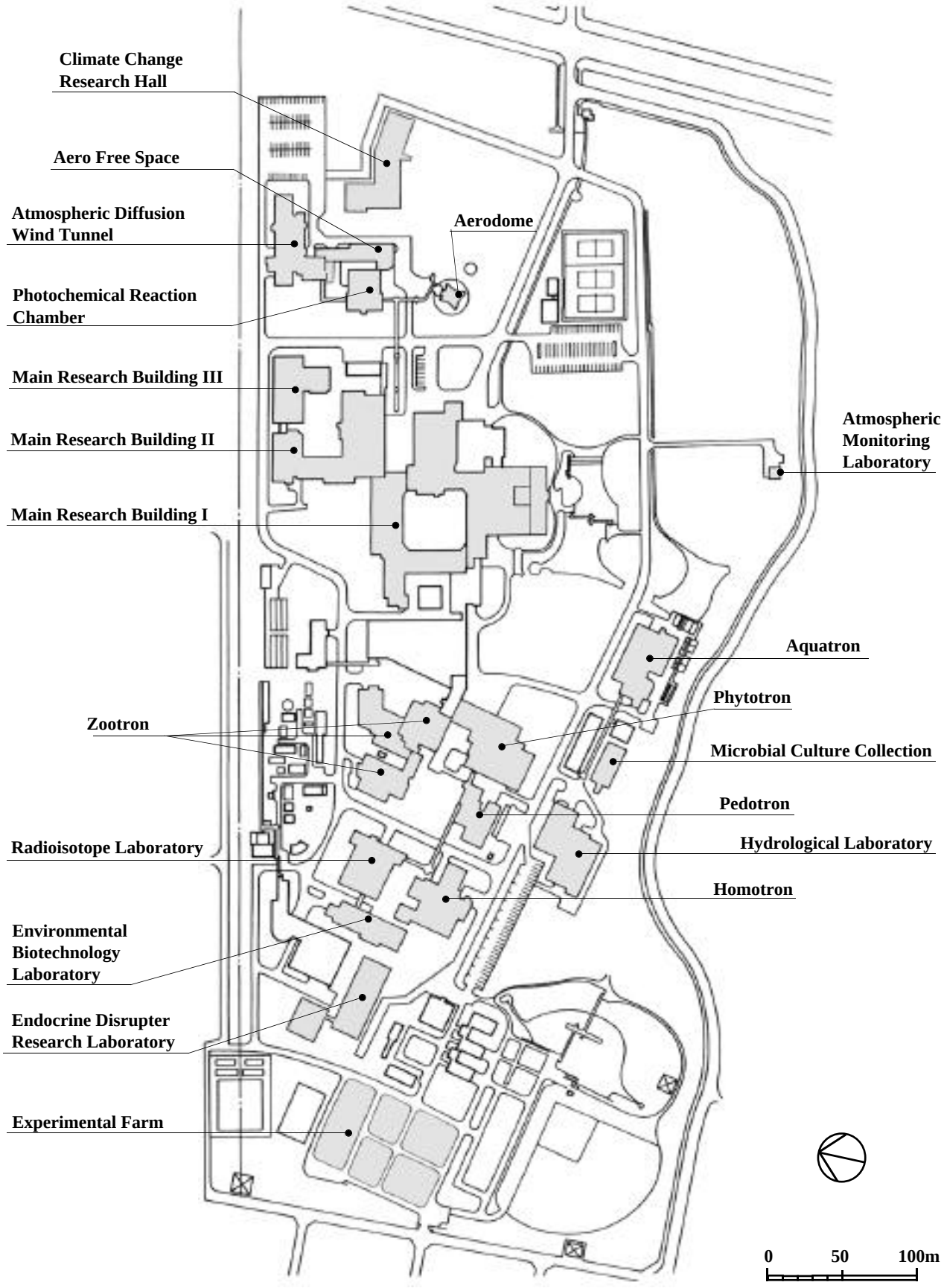
Climate Change Research Hall
Aero Free Space
Atmospheric Diffusion Wind Tunnel
Aerodome
Photochemical Reaction Chamber
Main Research Building III
Main Research Building II
Main Research Building I
Atmospheric Monitoring Laboratory
Aquatron
Phytotron
Zootron
Microbial Culture Collection
Pedotron
Hydrological Laboratory
Radioisotope Laboratory
Homotron
Environmental Biotechnology Laboratory
Endocrine Disrupter Research Laboratory
Experimental Farm
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100m

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.

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 Disruptor 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.

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
General Affairs Division	38
Executive Investigator	1
Principal Investigator	1
Social and Environmental Systems Division	19
Environmental Chemistry Division	14
Environmental Health Sciences Division	17
Atmospheric Environment Division	22
Water and Soil Environment Division	16
Environmental Biology Division	16
Climate Change Research Project	2
Ozone Layer Research Project	4
Endocrine Disruptors & Dioxin Research Project	14
Biodiversity Conservation Research Project	12
Watershed Environments and Management Research Project	7
PM2.5 & DEP Research Project	9
Research Center for Material Cycles and Waste Management	10
Research Center for Environmental Risk	4
Environmental Information Center	15
Laboratory of Intellectual Fundamentals for Environmental Studies	5
Center for Global Environmental Research	9
Total	247

Field of Expertise

Basic Sciences	84
Engineering	49
Agricultural Sciences	21
Medical Science	15
Pharmacology	5
Fisheries Science	3
Economics	3
Total	180

Division Section/Team	Position	Staff Member	Extension	E-mail (@nies.go.jp)
Headquarters				
	President	GOHSHI, Yohichi	2300	gohshi
	Executive Director (Research)	NISHIOKA, Shuzo	2820	snishiok
	Executive Director (Management)	HAMADA, Yasutaka	2301	yhamada
	Auditor	TOMIURA, Azusa	2822	
	Auditor	OTSUKA, Hiroshi	2823	
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	2403	koresawa
	Research Coordinator	SUGIYAMA, Kenichirou	2307	kensugi
	Research Coordinator ( )	TANAKA, Atsushi	2305	tanako
	Research Coordinator ( )	TOMIOKA, Noriko	2306	tomioka
Office of International Coordination				
	Chief ( )	OTSUBO, Kuninori	2827	kuninori
	International Coordination Reseacher	SHIMIZU, Hideyuki	2309	hshimizu
	International Research Coordinator	HIROKANE, Katsunori	2308	hirokane
General Affairs Division				
	Director	SAITO, Teruo	2311	steruo
General Affairs Section				
	Chief	ONISHI, Shigeru	2312	sonishi
Accounting Section				
	Chief	INABA, Hiroshi	2319	inaba
Facility Management Section				
	Chief	USUKI, Tamio	2325	usuki
Audit 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
		KAWASHIMA, Yasuko	2430	ykawas
Resources Management Section				
	Leader	MORIGUCHI, Yuichi	2540	moriguti
		MORI, Yasufumi	2539	mori-y
		TERAZONO, Atsushi	2506	terazono
Environmental Planning Section				
	Leader	HARASAWA, Hideo	2507	harasawa
		TAKAHASHI, Kiyoshi	2543	ktakaha
		HIJIOKA, Yasuaki	2961	hijioka
Information Processing and Analysis Section				
	Leader ( )	TAMURA, Masayuki	2479	m-tamura
		SUGA, Shinsuke	2456	sugas
		SHIMIZU, Akira	2452	ashimizu
		YAMANO, Hiroya	2477	hyamano

(*) Multiple roles

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
Deputy Director	FUJII, Toshihiro	2516	t-fujii
Independent Senior Researcher	KAWAI, Takayoshi	2429	tkawai
Independent Senior Researcher	YOKOUCHI, Yoko	2549	yokouchi
Analytical Instrumentation and Methodology Section			
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	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	seyamah
	TANAKA, Atsushi	2476	tanako
	YONEDA, Minoru	2552	myoneda
Ecological Chemistry Section			
Leader ( )	MORITA, Masatoshi	2332	mmorita
	HORIGUCHI, Toshihiro	2522	thorigu
Environmental Health Sciences Division			
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Deputy Director	KOBAYASHI, Takahiro	2439	takakoba
Molecular and Cellular Toxicology Section			
Leader	AOKI, Yasunobu	2390	ybaoki
	OHSAKO, Seiichiro	2519	ohsako
	MATSUMOTO, Michi	2528	michi
	ISHIMURA, Ryuta	2397	ishimura
Environmental Biodefense Research Section			
Leader	FUJIMAKI, Hidekazu	2518	fujimaki
	KUROKAWA, Yoshika	2437	kurokawa
	NOHARA, Keiko	2500	keikon
	MOCHITATE, Katsumi	2538	mochitat
	YAMAMOTO, Shoji	2548	snyamamo
Biomarker and Health Indicator Section			
Leader ( )	TOHYAMA, Chiharu	2336	ctohyama
	SATOH, Masahiko	2448	masahiko
	MIYABARA, Yuichi	2523	miyabara
	XING, Cui	2892	xing.cui
Epidemiology and International Health Research Section			
Leader	ONO, Masaji	2421	onomasaj
	TAMURA, Kenji	2520	ktamura
	ARAKAKI, Tazusa	2916	tazusa
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
	EMORI, Seita	2498	emori
	SUGATA, Seiji	2457	sugatas
	NOZAWA, Toru	2530	nozawa
	HIGURASHI, Akiko	2423	hakiko

(*) Multiple roles

Atmospheric Chemical Reaction Section			
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	SAKAMAKI, Fumio	2442	fsakamak
	TAKAMI, Akinori	2509	takamia
	SATO, Kei	2414	kei
	INOMATA, Satoshi	2403	ino
	TANIMOTO, Hiroshi	2930	tanimoto
Atmospheric Remote Sensing Section			
Leader	SUGIMOTO, Nobuo	2459	nsugimot
	MATSUI, Ichiro	2526	I-matsui
	SHIMIZU, Atsushi	2489	shimizua
Atmospheric Measurement Section			
Leader ( )	SASANO, Yasuhiro	2444	sasano
	UCHIYAMA, Masahiro	2411	utiyama
	TOHJIMA, Yasunori	2485	tohjima
	MACHIDA, Toshinobu	2525	tmachida
	TAKAHASHI, Yoshiyuki	2468	yoshiyu
Acid Deposition Research Team			
Leader	SATAKE, Kenichi	2447	ksatake
( )	TAKAMATSU, Takejirou	2469	takamatu
( )	NOHARA, Seiichi	2501	snohara
( )	HATAKEYAMA, Shiro	2502	hatashir
( )	MURANO, Kentaro	2537	murano
Water and Soil Environment Division			
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Deputy Director	OTSUBO, Kuninori	2417	kuninori
Water Quality Science Section			
Leader	UCHIYAMA, Hiroo	2412	huchiyam
	TOMIOKA, Noriko	2487	tomioka
Soil Science Section			
Leader	TAKAMATSU, Takejirou	2469	takamatu
	MUKAI, Satoshi	2535	mukaisa
	HAYASHI, Seiji	2599	shayashi
	MURATA, Tomoyoshi	2413	tmurata
	KOSHIKAWA, Masami	2440	mkanao
Geotechnical Engineering Section			
Leader	TOHNO, Ikuo	2484	tohno
	DOI, Taeko	2488	tdoi
	INABA, Kazuho	2399	inabakz
Lake Environment Section			
Leader	IMAI, Akio	2405	aimai
	MATSUSHIGE, Kazuo	2527	matusige
Ocean Environment Section			
Leader	HARASHIMA, Akira	2508	harashim
	NAKAMURA, Yasuo	2492	yasuo
Environmental Biology Division			
Director	WATANABE, Makoto	2555	mmw
Deputy Director	HATAKEYAMA, Shigehisa	2503	hata-tox
Ecosystem Function Study Section			
Leader	NOHARA, Seiichi	2501	snohara
	NATORI, Toshiki	2494	tnatori
	MIYASHITA, Mamoru	2534	miyasita
	SATAKE, Kiyoshi	2446	satanii
	YABE, Tohru	2533	yabet
Biodiversity and Phylogenetic Study Section			
Leader	KASAI, Fumie	2424	kasaif
	HIROKI, Mikiya	2513	hiroki-m
	UENO, Ryuhei	2408	uenor
	KAWACHI, Masanobu	2345	kawachi

(*) Multiple roles

Tropical Ecology Section			
Leader	OKUDA, Toshinori	2426	okuda
	TANG, Yanhong	2841	tangyh
Molecular Ecotoxicology Section			
Leader	SAJI, Hikaru	2445	hsaji
	KUBO, Akihiro	2435	kub
	AONO, Mitsuko	2391	maono
Climate Change Research Project			
Director ( )	MORITA, Tsuneyuki	2541	t-morita
Deputy Director ( )	INOUE, Gen	2402	inouegen
Carbon Cycle Research Team			
Leader	NOJIRI, Yukihiro	2499	nojiri
	MUKAI, Hitoshi	2536	lnmukaih
( )	TOHJIMA, Yasunori	2485	tohjima
( )	MACHIDA, Toshinobu	2525	tmachida
( )	TAKAHASHI, Yoshiyuki	2468	yoshiyu
Carbon Sink Research Team			
Leader ( )	YAMAGATA, Yoshiki	2545	yamagata
Socio-economic & Emission Modeling Team			
Leader ( )	KAINUMA, Mikiko	2422	mikiko
( )	KAWASHIMA, Yasuko	2430	ykawas
( )	HIBIKI, Akira	2510	hibiki
( )	MASUI, Toshihiko	2524	masui
( )	FUJINO, Junichi	2504	fuji
Climate Modeling Team			
Leader ( )	KANZAWA, Hiroshi	2431	kanzawa
( )	EMORI, Seita	2498	emori
( )	NOZAWA, Toru	2530	nozawa
( )	HIGURASHI, Akiko	2423	hakiko
Impact & Adaptation Modeling			
Leader ( )	HARASAWA, Hideo	2507	harasawa
( )	TAKAHASHI, Kiyoshi	2543	ktakaha
Ozone Layer Research Project			
Director ( )	SASANO, Yasuhiro	2444	sasano
Satellite Remote Sensing Research Team			
Leader	NAKAJIMA, Hideaki	2800	hide
	SUGITA, Takafumi	2460	tsugita
( )	KANZAWA, Hiroshi	2431	kanzawa
( )	YOKOTA, Tatsuya	2550	yoko
Ground-based Remote Sensing Research Team			
Leader ( )	NAKANE, Hideaki	2491	nakane
Ozone Layer Modeling Research Team			
Leader	IMAMURA, Takashi	2406	imamura
	AKIYOSHI, Hideharu	2393	hakiyusi
Endocrine Disruptors & Dioxin Research Project			
Director ( )	MORITA, Masatoshi	2332	mmorita
Deputy Director ( )	TOHYAMA, Chiharu	2336	ctohyama
Chemical, Bioassay & Dynamics Research Team			
Leader ( )	SHIRAISHI, Hiroaki	2455	hirosira
	SHIRAISHI, Fujio	2454	fujios
( )	KAYA, Kunimitsu	2428	kayakuni
( )	TAKAGI, Hiroo	2465	takakiho
Biological Function Assessment Team			
Leader	MITSUMORI, Fumiyuki	2532	mitumori
	UMEZU, Toyoshi	2415	umechan
	YAMANE, Kazusuke	2419	kyamane
( )	KUROKAWA, Yoshika	2437	kurokawa

(*) Multiple roles

Pathophysiology Research Team			
Leader	TAKANO, Hirohisa	2334	htakano
	ISHIDO, Masami	2396	ishidou
	IMAI, Hideki	2404	imahide
Health Effects Research Team			
Leader	YONEMOTO, Junzo	2553	yonemoto
	SONE, Hideko	2464	hsone
( )	MIYABARA, Yuichi	2523	miyabara
Ecological Effect Research Team			
Leader ( )	HATAKEYAMA, Shigehisa	2503	hata-tox
	TAKAHASHI, Shinji	2467	stakahas
	TADA, Mitsuru	2475	mtada
( )	SUGAYA, Yoshio	2503	sugaya
( )	HORIGUCHI, Toshihiro	2522	thorigu
Counter Measurement & Engineering Team			
Leader ( )	YASUHARA, Akio	2544	yasuhara
	HASHIMOTO, Shunji	2531	shunji
( )	ITO, Hiroyasu	2398	h-ito
Research Integration Team			
Leader	SUZUKI, Noriyuki	2331	nsuzuki
	SAKURAI, Takeo	2801	tsakurai
Biodiversity Conservation Research Project			
Director ( )	WATANABE, Makoto	2555	mmw
Deputy Director	TSUBAKI, Yoshitaka	2482	tsubaki
Wildlife Population Research Team			
Leader	TAKAMURA, Kenji	2470	takaken
	NAGATA, Hisashi	2493	hnagata
Biological Invasion Research Team			
Leader	KASUGA, Seiichi	2425	skasuga
	GOKA, Koichi	2480	goka
Community Dynamics Research Team			
Leader	TAKENAKA, Akio	2474	takenaka
	YOSHIDA, Katsuhiko	2443	kyoshida
Ecological Landscape Research Team			
Leader	TAKAMURA, Noriko	2471	noriko-t
	FUKUSHIMA, Michio	2427	michio
Biotechnology Risk Assessment Team			
Leader ( )	UCHIYAMA, Hiroo	2412	huchiyam
	IWASAKI, Kazuhiro	2407	kiwasaki
	NAKAJIMA, Nobuyoshi	2490	naka-320
	TAMAOKI, Masanori	2466	mtamaoki
( )	TOMIOKA, Noriko	2487	tomioka
Watershed Environments and Management Research Project			
Director ( )	WATANABE, Masataka	2338	masawata
Watershed Environments Research Team			
Leader	MURAKAMI, Shogo	2388	murakami
	XU, Kaiqin	2339	joexu
	KAMEYAMA, Satoshi	2401	kame
	NAKAYAMA, Tadanobu	2564	nakat
( )	HAYASHI, Seiji	2599	shayashi
Coastal Environment Research Team			
Leader	KOHATA, Kunio	2438	kohata
	KOSHIKAWA, Hiroshi	2505	koshikaw
	MAKI, Hideaki	2394	hidemaki
Remote Sensing Data Analysis Team			
Leader ( )	TAMURA, Masayuki	2479	m-tamura
( )	YAMANO, Hiroya	2477	hyamano

(∗) Multiple roles

PM2.5 & DEP Research Project

Director	WAKAMATSU, Sinji	2554	wakamatu
Deputy Director ( )	KOBAYASHI, Takahiro	2439	takakoba
Independent Senior Researcher	MATSUMOTO, Yukio	2529	y-matsu
Traffic Pollution Control Research Team			
Leader ( )	MORIGUCHI, Yuichi	2540	moriguti
	KONDO, Yoshinori	2441	kondos
	MATSUHASHI, Keisuke	2511	matuhasi
( )	TANABE, Kiyoshi	2478	tanabe
Urban Air Quality Research Team			
Leader ( )	WAKAMATSU, Sinji	2554	wakamatu
	UEHARA, Kiyoshi	2409	kuehara
( )	SAKAMAKI, Fumio	2442	fsakamak
( )	SUGATA, Seiji	2457	sugatas
Aerosol Measurement Research Team			
Leader	FUKUYAMA, Tsutomu	2515	fukuyamt
( )	UCHIYAMA, Masahiro	2411	utiyama
( )	NISHIKAWA, Masataka	2495	mnishi
Epidemiology and Exposure Assessment Research Team			
Leader	NITTA, Hiroshi	2497	nitta
( )	ONO, Masaji	2421	onomasaj
( )	TAMURA, Kenji	2520	ktamura
Inhalation Toxicology Team			
Leader ( )	TAKANO, Hirohisa	2334	htakano
	SUZUKI, Akira	2461	suzukiak
	FURUYAMA, Akiko	2521	kawagoe

Research Center for Material Cycles and Waste Management

Director	SAKAI, Shinichi	2806	sakai
Research Coordinator ( )	KORESAWA, Yuji	2403	koresawa
Sustainable Material Cycles Management Section			
Leader ( )	MORIGUCHI, Yuichi	2540	moriguti
( )	TERAZONO, Atsushi	2506	terazono
( )	MORI, Yasufumi	2539	mori-y
Material Cycles Engineering Section			
Leader	GOTO, Sumio	2834	sumiogoto
Waste Treatment Engineering Section			
Leader	IKEGUCHI, Takashi		ikeguchi
Final Disposal Engineering Section			
Leader	INOUE, Yuzo	2836	yinoue
	YAMADA, Masato	2837	myamada
Testing and Assessment Section			
Leader	YASUHARA, Akio	2544	yasuhara
	YAMAMOTO, Takashi	2547	tyama
( )	HASHIMOTO, Shunji	2531	shunji
Hazardous Waste Management Section			
Leader ( )	SAKAI, Shinichi	2806	sakai
	OSAKO, Masahiro	2835	mosako
( )	SUZUKI, Noriyuki	2331	nsuzuki
Bio & Eco Engineering Section			
Leader	INAMORI, Yuhei	2400	inamori
	MIZUOCHI, Motoyuki	2496	mizuochi

Research Center for Environmental Risk

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( )	KABUTO, Michinori	2333	kabuto
( )	SUZUKI, Noriyuki	2331	nsuzuki
( )	GOTO, Sumio	2834	sumiogoto
Exposure Assessment Section			
Leader	SHIRAISHI, Hiroaki	2455	hirosira

(*) Multiple roles

Health Risk Assessment Section			
Leader ( )	AOKI, Yasunobu	2390	ybaoki
( )	MATSUMOTO, Michi	2528	michi
Ecological Risk Assessment Section			
Leader ( )	NAKASUGI, Osami	2335	nakasugi
	SUGAYA, Yoshio	2458	sugaya
Environmental Information Center			
Director	KONDA, Choei	2340	chkonda
Information Management Section			
Chief	ABE, Shigenobu	3361	sabe
Database Section			
Chief	SHIRAI, Kunihiko	3366	shiro
Library and Research Information Section			
Chief	TAKEUCHI, Hisanori	3371	takehisa
Laboratory of Intellectual Fundamentals for Environmental Studies			
Director	KAYA, Kunimitsu	2428	kayakuni
Research Laboratory (Section) of Environmental Analytical Chemistry			
Leader ( )	KAYA, Kunimitsu	2428	kayakuni
	SANO, Motoharu	2449	sanotomo
	TAKAGI, Hiroo	2465	takakiho
( )	SHIBATA, Yasuyuki	2450	yshibata
( )	ITO, Hiroyasu	2398	h-ito
( )	NISHIKAWA, Masataka	2495	mnishi
Research Laboratory (Section) of Biological Resources and Informatics			
Leader ( )	KASAI, Fumie	2424	kasaif
	SHIMURA, Junko	2472	jyunko
	TOBE, Kazuo	2486	tobe
( )	KAWACHI, Masanobu	2345	kawachi
( )	SUGAYA, Yoshio	2503	sugaya
( )	TAKAHASHI, Shinji	2467	stakahas
Center for Global Environmental Research			
Executive Director ( )	NISHIOKA, Shuzo	2820	snishiok
Director	INOUE, Gen	2402	inouegen
Research Program Manager	FUJINUMA, Yasumi	2517	fujinuma
Research Program Manager	YAMAGATA, Yoshiki	2545	yamagata
Research Program Manager	YOKOTA, Tatsuya	2550	yoko
	ICHINOSE, Toshiaki	2598	toshiaki
	OGUMA, Hiroyuki	2983	oguma
( )	TAMURA, Masayuki	2479	m-tamura
( )	HARASAWA, Hideo	2507	harasawa
( )	MORIGUCHI, Yuichi	2540	moriguti
( )	KAINUMA, Mikiko	2422	mikiko
( )	KAWAI, Takayoshi	2429	tkawai
( )	ONO, Masaji	2421	onomasaj
( )	NAKANE, Hideaki	2491	nakane
( )	KANZAWA, Hiroshi	2431	kanzawa
( )	TOHJIMA, Yasunori	2485	tohjima
( )	MACHIDA, Toshinobu	2525	tmachida
( )	MATSUSHIGE, Kazuo	2527	matusige
( )	OKUDA, Toshinori	2426	okuda
( )	NOJIRI, Yukihiro	2499	nojiri
( )	MUKAI, Hitoshi	2536	lnmukaih
( )	NAKAJIMA, Hideaki	2800	hide
( )	ABE, Shigenobu	2341	sabe

(*) Multiple roles

ADEOS	Advanced Earth Observing Satellite
AGCM	Atmospheric General Circulation Model
AHS	aquatic humic substances
AIM	Asian-Pacific Integrated Model
APARE	East Asia/North Pacific Regional Experiment
APN	Asia-Pacific Network for Global Change Research
ARD	Afforestation, Reforestation and Deforestation
AVHRR	Advanced Very High Resolution Radiometer
BAHC	Biospheric Aspects of the Hydrologic Cycle
b-GAL	β-galactosidase
CCD	Convention to Combat Desertification
CCSR	Center for Climate System Research, the University of Tokyo
CDM	Clean Development Mechanism
CGER	Center for Global Environmental Research
COD	chemical oxygen demand
CRA	comparative risk assessment
CRM	certified reference material
CTM	Chemical Transport Model
DEM	Digital Elevation Model
DHF	Data Handling Facility
DIC	dissolved inorganic carbon
DOM	dissolved organic matter
EANET	Acid Deposition Monitoring Network in East Asia
EC_{50}	50% effective concentration
ELF-EMF	extremely low-frequency electromagnetic fields ER-ELISA enzyme-linked immunosorbent assay
ESA	European Space Agency
FA	Fluctuating Asymmetry
FAO	Food and Agriculture Organization of the United Nations
FTIR	Fourier Transform InfraRed Spectrometer
FTS	Fourier Transform Spectrometer
GBIF	Global Biodiversity Information Facility
GCM	General Circulation Model
GECHS	Global Environmental Change and Human Security
GEMS/Water	Global Environmental Monitoring System/ Assessment of Freshwater Quality
GOES	Global Omnibus Environmental Study
GRID	Global Resource Information Database
HDP	Human Dimensions Programme on Global Change
HiA	hydrophilic acids
IGAC	International Global Atmospheric Chemistry
IGBP	International Geosphere Biosphere Programme
IHDP	International Human Dimension Program on Global Environment Change
ILAS	Improved Limb Atmospheric Spectrometer
ILAS-II	Improved Limb Atmospheric Spectrometer-II
IPCC	Intergovernmental Panel on Climate Change
ISO	International Standard Organization
IT	Industrial Transformation
LAN	Local Area Network
LCA	Life-Cycle Assessment
LCIA	life-cycle impacts assessment
LU/GEC	Land Use for Global Environmental Conservation
LUCC	Land use/Cover Change
LUTEA	LUCC under Temperate East Asia
MIP	Microwave-Indused Plazuma
NASDA	National Space Development Agency of Japan
NCEP	National Centers for Environmental Prediction
NDVI	Normalized Difference Vegetation Index
NOAA	National Oceanic and Atmospheric Administration
NPP	Net Primary Production
O8CDD	octachlorodibenzo-*p*-dioxin
PCDDs	polychlorinated dibenzo-*p*-dioxins
PCDFs	polychlorinated dibenzofurans
PEACAMPOT	Perturbation by the East Asia Continental Air Mass to the Pacific Oceanic Troposphere
PRTR	Pullutant Release and Transfer Resister
PT-PCR	reverse-transcription polymerase chain reaction
PV	Potential Voricity
RIS	Retroreflector In Space
SIMS	secondary ion mass spectrometry
SNIFF	Scientist Network on Indonesian Forest Fires
SOFIS	Solar Occultation FTS for Inclined-orbit Satellite
START	Global Change SysTem for Analysis, Research Training
TAGB	total above ground biomass
TBT	tributyltin
TDM	traffic demand management
TEACOM	Temperate East Asia Planning Committee for START
TPN	Thematic Programme Network
TPT	triphenyltin
UNEP	United Nations Environment Programme
UV-B	ultraviolet-B
VOC	volatile organic compounds
WHO	World Health Organization
WWW	World Wide Web
XPS	X-ray photoelectron spectroscopy