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NIES Annual Report 1994

National Institute for Environmental Studies

Foreword

It has been 3 years since the United Nation Conference on Environment and Development in Rio de Janeiro, Brazil in June 1992 offered us an excellent opportunity to gather people's opinions and to make decisions at the global level. During the interim, the Japanese government has endeavored to put the outcome of the conference into practice, and in 1993 the Environment Basic Law was enacted. The concept of this law is that people should live in harmony with the environment, making the wisest possible use of both the local and global environment.

The National Institute for Environmental Studies (NIES) reorganized its research system in 1990 in order to cope with changes in the global environment such as global warming, depletion of the ozone layer, loss of biodiversity, etc. The institute is carrying out multidisciplinary research activities consistent with the concept of the Environment Basic Law.

This annual report presents an outline of the research activities of NIES in FY 1994 summarizing our organization, research programs, publications, etc. I hope that this annual report will attract the interest of many people concerned with environmental issues throughout the world and will be of assistance in strengthening the relationships among us.

Tsuguyoshi Suzuki
Director General

Contents

During the 1950s and 1960s, Japan experienced serious environmental pollution problems accompanying the rapid economic growth which followed World War II. 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 Monitoring Station-Hateruma.

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 elucidate the adverse effects of environmental pollution on human health, to search for countermeasures to these threats, 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 Senior 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.

In FY 1994, the total number of NIES personnel was 274 (Table 1) and the total budget was 8,072 million yen (Table 2).

Table 1
Total Number of Personnel

Research	179	65.4%
Management	48	17.5%
Env. Information Center	19	6.9%
Center for Global Env. Research	9	3.3%
Env. Training Institute	19	6.9%
Total	274	100%

(as of the end of FY 1994)

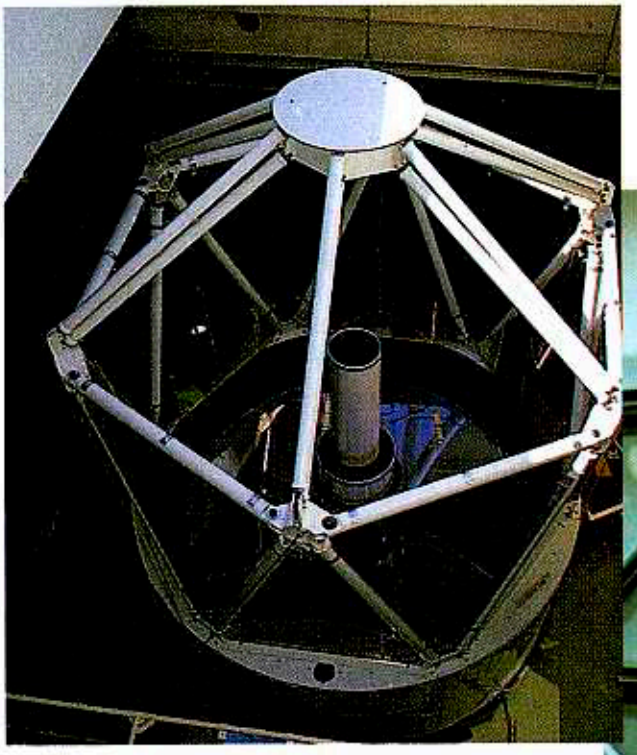
Table 2
Budget in Millions of Yen

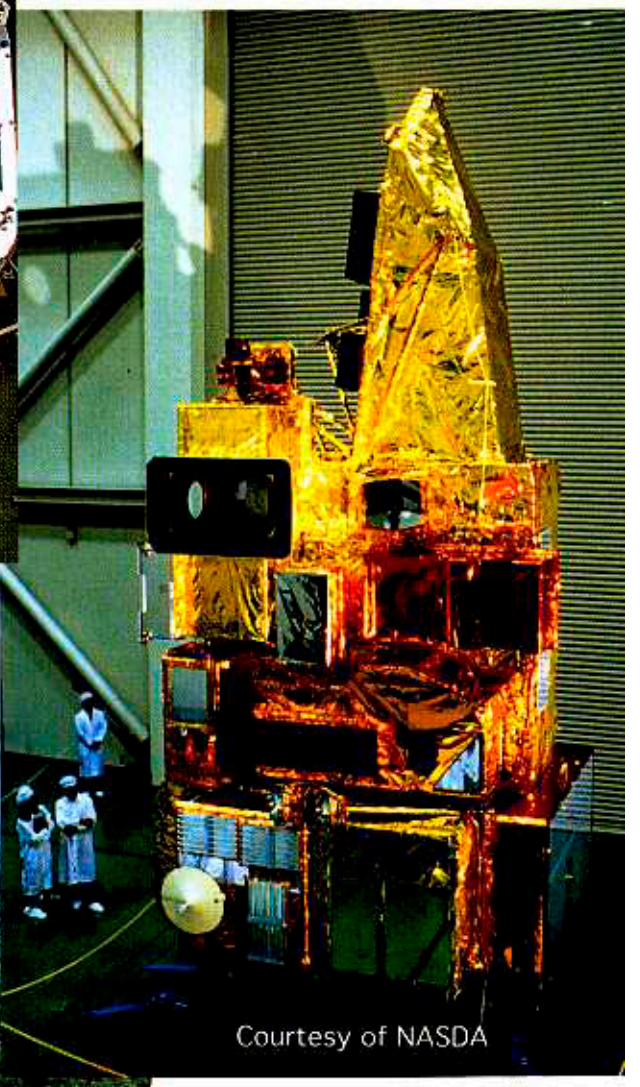
	Item	FY 1992	FY 1993	FY 1994	
1.	Primary budget				(% of total)
	Personnel	1,961	2,051	2,115	(31.5%)
	Research	548	1,547	587	(8.8%)
	Facilities operations & maintenance	1,199	1,312	1,290	(19.2%)
	Info. & related research	389	387	412	(6.1%)
	Center for Global Env. Research	1,272	1,392	1,668	(24.8%)
	Env. Training Institute	95	99	100	(1.5%)
	Administration	331	331	338	(5.0%)
	Facilities maintenance and repairs	832	6,240	205	(3.1%)
	Total	6,627	13,359	6,715	(100%)
2.	Additional resources from external research funds				
	EA Research funds	881	962	1,041	
	STA Research funds	274	270	316	
	Total	1,155	1,232	1,357	

(EA=Environment Agency, STA=Science and Technology Agency)

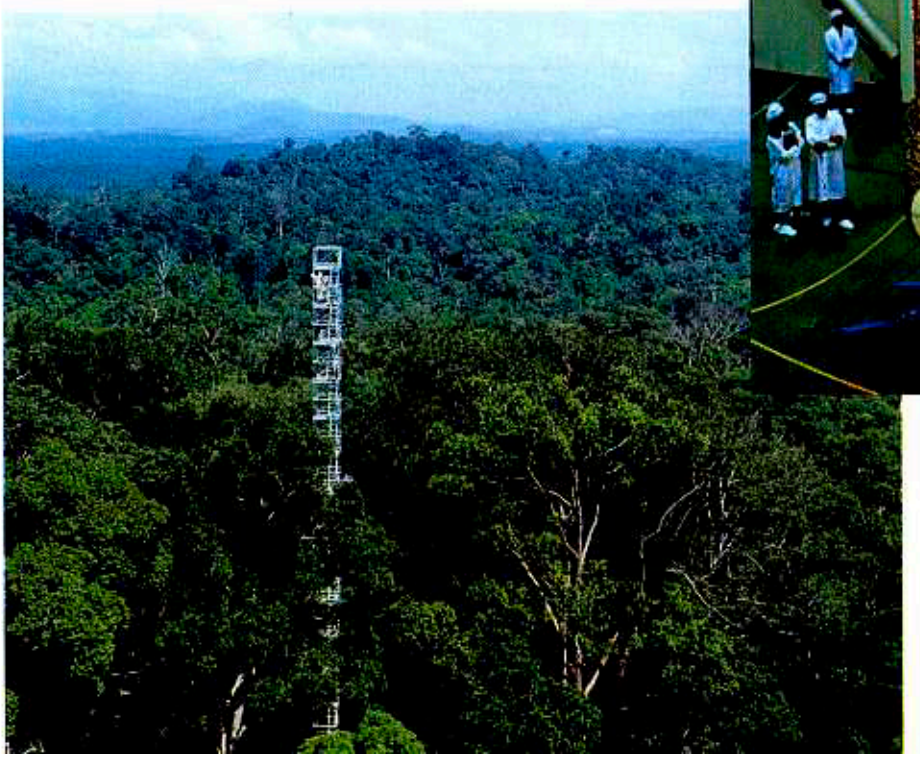
Fig. 1
Organization of the National Institute for Environmental Studies

Global Environment Division





Courtesy of NASDA



This group consists of eight research teams which cover the major global change issues. However, many researchers belonging to other divisions or other institutions are cooperating with us to address global change questions. Not all of these research projects are included in the present report. We introduce here current studies being conducted by the respective teams and portions of the projects. Research reports or proceedings from the respective teams have been published separately and are available upon request.

Global Warming Mechanism Research Team

Methane emissions from natural wetlands and carbon dioxide exchange between the atmosphere and terrestrial ecosystems have been studied as a part of the Siberian Terrestrial Ecosystem-Atmosphere-Cryosphere Experiment (STEACE). Methane fluxes from a wetland in western Siberia varied considerably from place to place, but were typically 200 mg CH_4/m^2/day in summer when measured on a spatial scale of one meter by the chamber method. Methane emitted from wetlands to the atmosphere is transported to the mixed layer in the daytime by thermal convection. However at night, a strong temperature inversion is formed and methane accumulates near the surface. From the accumulation time and vertical concentration profiles, the methane emission rate was estimated to be 120 mg CH_4/m^2/day, typically, over a spatial scale of several tens of km. Seasonal variations in the vertical CH_4 concentration profile have been observed by repeated air sampling from aircraft. The high concentration in summer can be ascribed to strong wetland sources, from which there is no emission in autumn. High concentrations near the ground surface in winter might be due to leakage from a natural gas pipeline.

The CO_2 concentration variations near the surface in summer are more complicated because of the strong CO_2 uptake by plant photosynthesis in the daytime and the CO_2 emissions by respiration of plants and soil microbes. In the daytime, low CO_2 air is transported to the boundary layer by thermal convection up to about 2000m. The CO_2 concentration of this air is lower than that in the free troposphere by as much as 10 ppm. This air sometimes is transported to the free troposphere by strong convection, resulting in the reduction of CO_2 to the base line atmospheric concentration of the Northern Hemisphere. Variations in the vertical CO_2 concentration profile and stable isotope analyses support the above conclusions.

The research at Yakutsk, eastern Siberia, found that methane was producted in the sediments of permafrost lakes by biological reduction of carbon dioxide.

Global Warming Response Team

This team has been developing the Asian-Pacific Integrated Model (AIM). This model assesses options for stabilizing the global climate, particularly in the Asia-Pacific region, with the objectives of reducing greenhouse gas emissions and avoiding the impacts of climate change. AIM is special in that it integrates emission, climate and impact models to facilitate policy assessment. It also integrates modules for countries in the region with a global model (Fig. 1).

In the emission model, a variety of global and regional assumptions about such things as population growth, economic trends and government policies interact with the regional and country models to estimate energy consumption, land-use changes, etc. These estimates are used to predict emissions of greenhouse gases (GHGs) (Fig. 2).

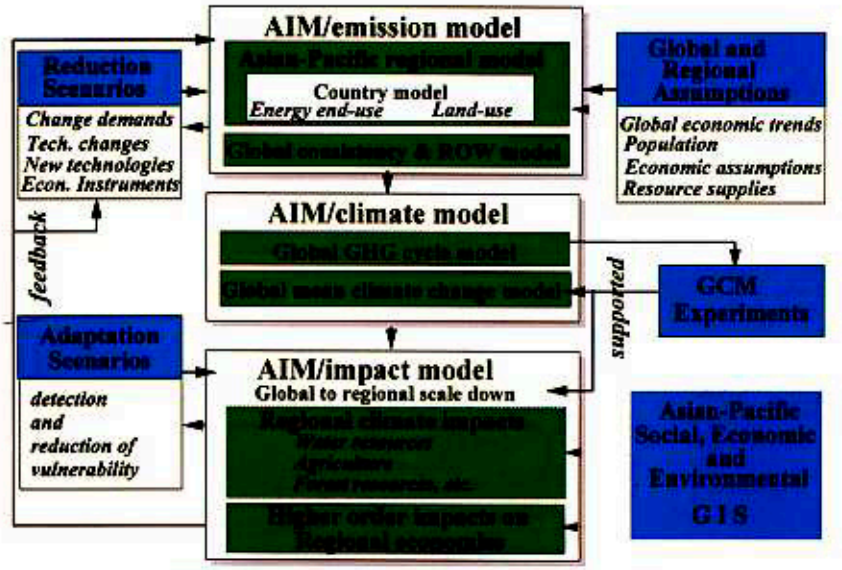


Fig. 1
Outline of the Asian - Pacific Integrated Model (AIM).

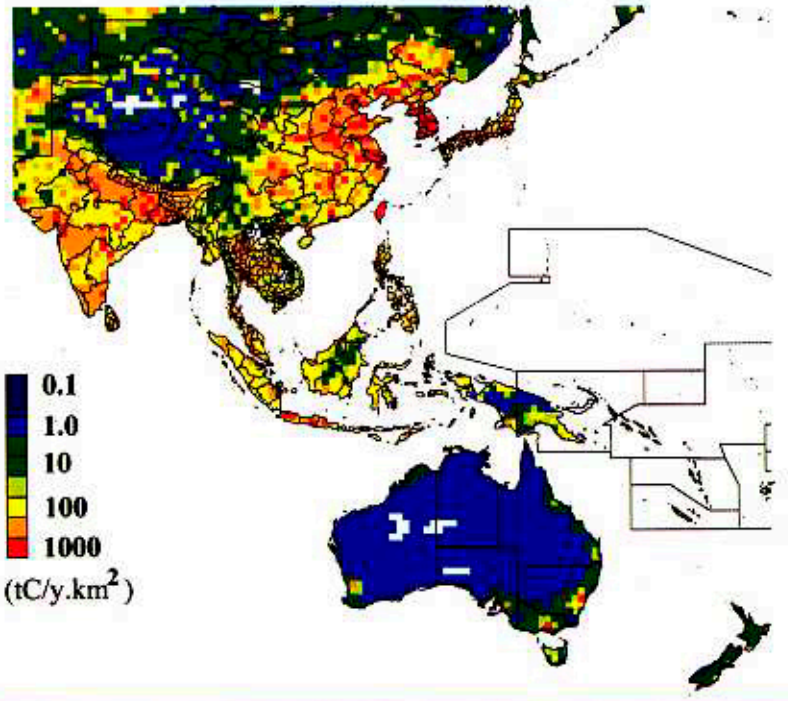


Fig. 2
CO_2 emission intensity estimated for the year 2100.

More than 100 technologies were evaluated for their potential to improve energy efficiency and reduce CO_2 emissions. Energy demand estimates were then linked to a top-down economic model. This approach was used to assess the effects of the introduction of a carbon tax. A detailed energy-technology model was applied to Japan, and similar Korean and Chinese models are being developed in conjunction with institutes in those countries.

The global components of the emission and climate models were used to analyze global scenarios for GHG emissions, atmospheric concentrations and temperature increases. Preliminary versions of these models and some new global modules have been developed, including a deforestation carbon flux module and a terrestrial carbon cycle module. Figure 3 shows a regional comparison of tropical deforestation.

Several component models have already been developed for the impact model — a spatial water balance model, a vegetation change model and a malaria distribution model. The output of the AIM water balance model shows changes in low flow discharges over a 10 year period (Fig. 4). The red areas are expected to experience much drier dry periods. Recently, an agricultural impact model was developed and it shows the expected changes in potential productivity of winter wheat (Fig. 5). The red areas are those where productivity will decline, while the green areas are those where it will increase. A total decline of about 17% by 2100 is predicted.

The global module of AIM and a prototype of the regional country module have been tentatively completed. Recently, preparation of country-wide emission modules and regional impact models began in cooperation with developing countries of the region.

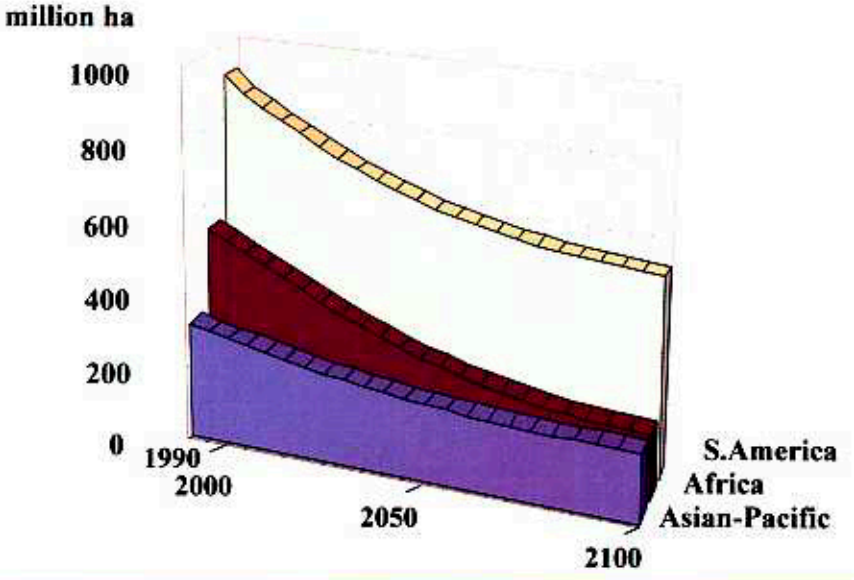


Fig. 3
Regional comparison of tropical deforestation.

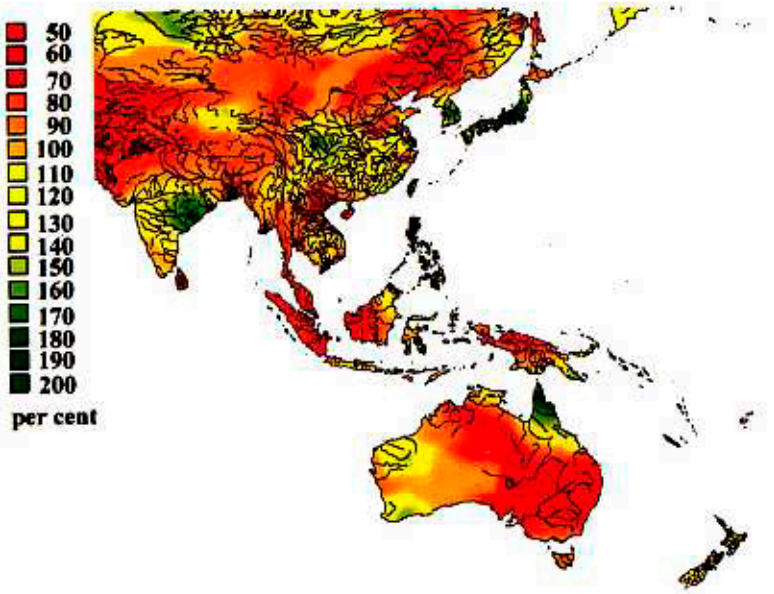


Fig. 4
Predicted ratios of monthly low-flow discharge (percentage of those for a doubling of atmospheric CO_2 content) over a 10 year return period.

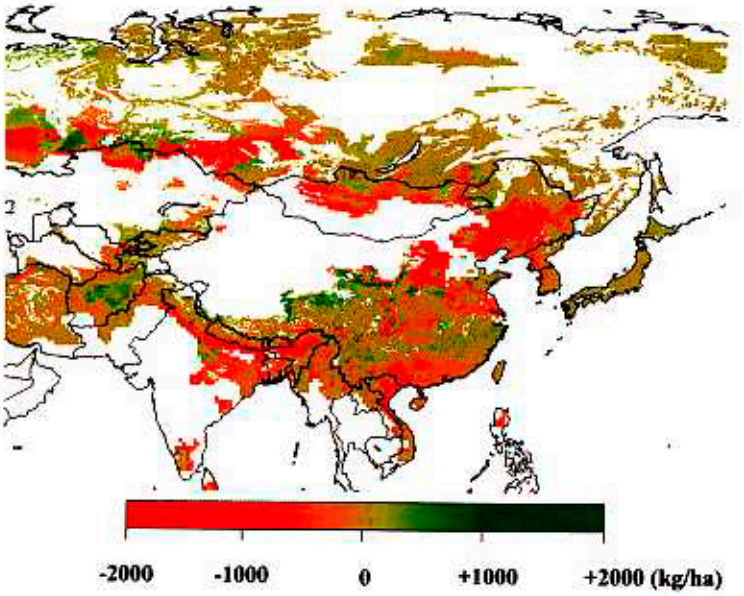


Fig. 5
Predicted winter wheat potential productivity changes from 1990 to 2100.

Many other related research projects for responding to global warming have also been promoted, including a project to assess the potential of various technologies to reduce greenhouse gas emissions and physical experiments on the impact of global climate change on vegetation and human health. The results of these projects will be integrated into the AIM model.

Ozone Layer Research Team

This team, in cooperation with scientists belonging to various groups and divisions in NIES, universities and other national institutes, is carrying out research on five sub-themes to explore the mechanisms of ozone depletion in the middle latitudes, to evaluate countermeasure technologies against ozone depletion, to develop new laser radar techniques and to clarify the effects of UV-B on the health of humans and plants.

A brief description of work conducted on the sub-theme, "Comprehensive observation and analysis of variability of the ozone layer" follows. To understand the mechanism of ozone depletion in the middle latitudes and to improve our ability to predict the future state of the ozone layer, long-term observations, field campaigns, data analyses and model simulations are necessary. In this three year project from FY 1993 to FY 1995, NIES and university groups are developing ozone lidars for lower stratospheric measurements, millimeter wave radiometers for ozone and ClO measurements, IR heterodyne spectrometers and visible light spectrometers. These instruments will be used for long-term observations such as those in the Network for the Detection of Stratospheric Change (NDSC) and field experiments such as the Second European Stratospheric Arctic and Mid-latitude Experiment (SESAME). During SESAME, ozone sondes, aerosol lidars, aerosol backscatter sondes, balloon-borne optical particle counters (OPC), Lyman-α hygrometers and ozone sondes are used. We observed vertical profiles of aerosols, water vapor and temperature at Yakutsk (60°N, 130°E) in eastern Siberia in cooperation with the Central Aerological Observatory (CAO), Russia and Nagoya University in the framework of SESAME.

This expedition obtained vertical profiles of aerosols (by backscatter, Fig. 6), ozone and temperature (measured by CAO, Fig. 7). Yakutsk was outside of the polar vortex on January 14 and March 1, but was inside the vortex on February 21 and March 16. Inside the polar vortex, ozone concentrations and temperatures were substantially lower between 13 and 23 km and aerosols decreased with altitude more sharply at the

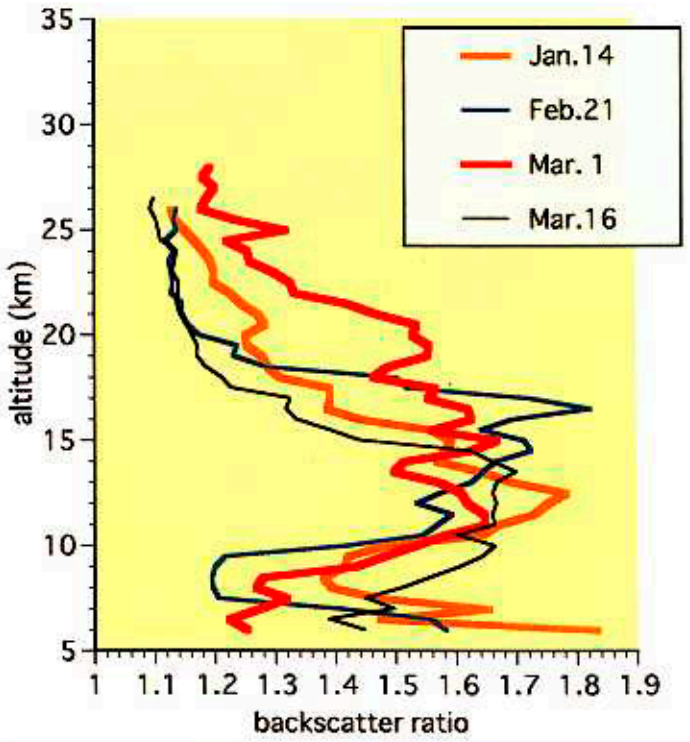


Fig. 6
Vertical profiles of aerosol concentrations measured with backscatter sondes at Yakutsk in 1995 by CAO and NIES. Aerosol concentrations are expressed in units of backscatter ratio-1 which equals the ratio of Mie scattering by aerosols to Rayleigh scattering by air molecules.

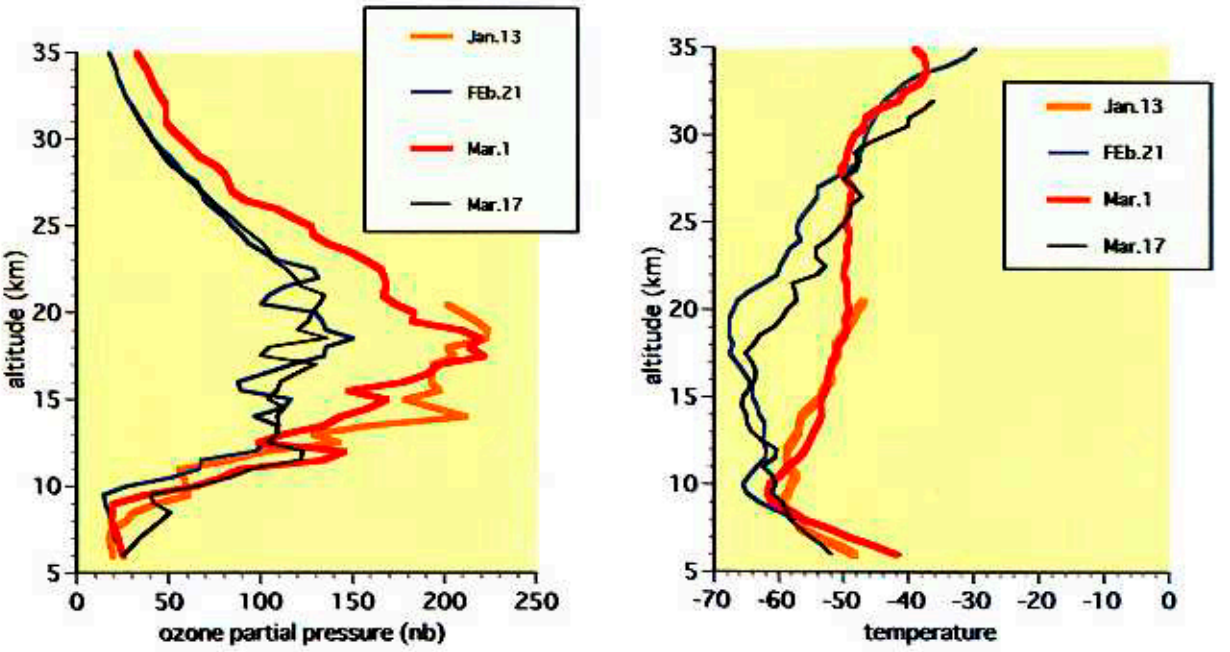


Fig. 7
(a) Ozone and (b) temperature profiles measured with ozone sondes at Yakutsk in 1995 (Courtesy of Drs. V. Yushkov (CAO) and V. Dorokhov (CAO)).

top of the ozone layer when compared with conditions when this region was not in the vortex. Though the polar vortex seems to be responsible for the ozone depletion over Yakutsk, more detailed analyses are necessary to understand the dominant chemical and dynamical processes occurring in the ozone layer during winter. Ozone and aerosols over Tsukuba were observed with laser radar during this same period. Radical-radical reactions related to the heterogeneous reactions responsible for ozone depletion were examined in laboratory studies. For the sub-theme "Development and evaluation of countermeasure technologies for the stratospheric ozone", the impact on humans of halon alternatives and the fate of halons and CFC substitutes emitted into the atmosphere were examined. In the sub-theme "Development of new measurement techniques with laser radars", a spectroscopic method for earth-satellite-earth laser long-path absorption measurements is being developed. A study of the feasibility of using space lidars to probe the global atmospheric environment is being carried out. For the sub-themes "Studies on health effects by the increase of ultraviolet ray", the carcinogenic effects of UV-B irradiation of skin and the formation of cataracts due to UV radiation have been studied using epidemiological and experimental methods. Defense and repair mechanisms at cellular and molecular levels have been studied as a part of the work on the sub-theme "Effects of enhanced UV-B radiation on terrestrial and marine vegetation and zooplankton".

Acid Deposition Research Team

Acidic and oxidative atmospheric species in East Asia

The East Asian area has some of the largest anthropogenic emissions of NO_x and SO_2 in the world. It is anticipated that during the 21st century, this area will become the largest source area for NO_x and SO_2 in the world due to rapid population growth and industrialization. In order to analyze the present status of the atmospheric environment in the western Pacific region, aircraft and ground-based surveys of atmospheric pollutants over the seas between the Asian continent and Japan have been conducted since 1991 as a part of the International Global Atmospheric Chemistry Project (IGAC)/East Asian-North Pacific Regional Experiment (APARE) activities. On November 12, 1992 we observed a very high SO_2 concentration, up to 10 ppb, near the Oki Islands, Japan. On March 11, 1994 several peaks of high SO_2 concentration were observed during a westward flight over the Sea of Japan (Fig. 8). Back trajectory analyses clearly showed the impact of emissions originating on the Asian continent including the Korean Peninsula.

We also compiled data for ammonia emissions from domestic animals and fertilizer application in Japan and South Korea on a 1° latitude × 1° longitude grid.

Impacts of acidic substances on natural ecosystems

The optimum *p*H for germination of the spores of *Armillaris mellea* was 6-6.5, but no germination was observed at *p*H less than 3. In contrast, the *p*H range for germination of the fungus in the presence of soil microorganisms was 4-4.5 and no spores germinated when *p*H was greater than 5 as a result of bacterial growth (Fig. 9). These findings suggest that increases in *A. mellea* are favored by acid conditions in the natural environment where the fungus competes with other microorganisms.

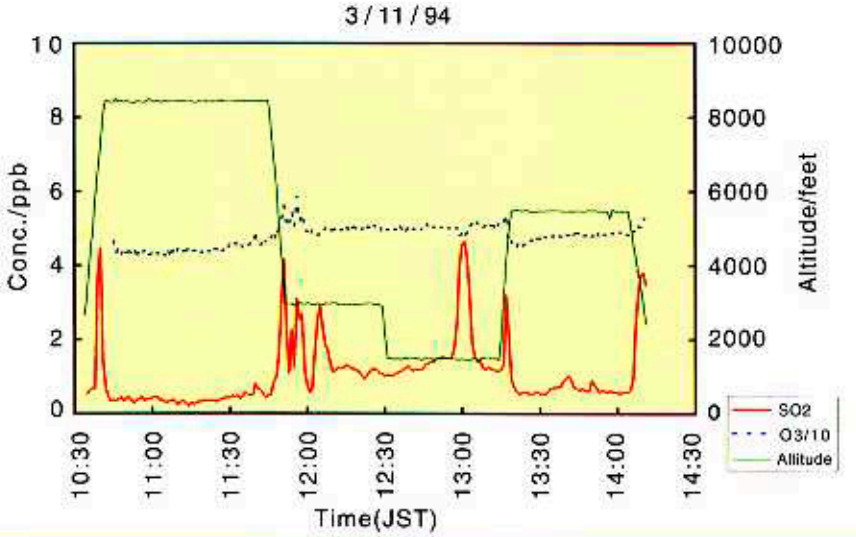


Fig. 8
Concentrations of ozone and SO_2 measured above the Sea of Japan between the Oki Islands and Nagasaki on March 11, 1994.

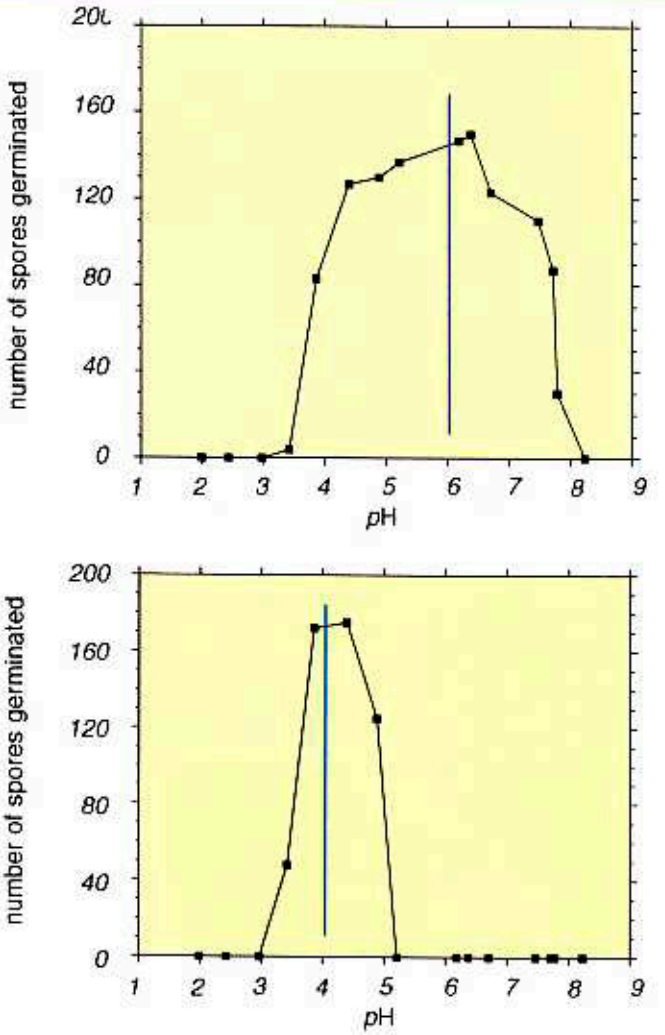


Fig. 9
Effects of *p*H on germination of *Armillaria mellea* spores upper in the absence and lower in the presence of soil microorganisms.

The *p*H distribution in the outer bark, inner bark, cambium and xylem layers of a conifer, *Cryptomeria japonica*, was measured using iridium oxide and flat-type glass electrodes. The outer bark *p*H was almost constant at about 3 throughout. The inner bark *p*H was about 4 to 6 and the *p*H was maximal (about 6.3) in the cambium. Water insoluble carboxyl (-COOH) groups bound to organic polymers contribute to the strong acidity of the outer bark.

Marine Environment Research Team

This team is studying anthropogenic disturbances of the elemental cycles of C, N and P, the discharges of man-made hazardous substances into the marine environment and the ocean's inherent role in stabilizing the global environment. These processes are strongly related to the function of marine ecosystems. The following four research projects are underway:

Study on the material flux on the continental shelf areas

The flux of carbon has been measured with a stable isotope in an experimental marine mesocosm. Shifts in phytoplankton species dominance were investigated following nutrient enrichments which simulated anthropogenic perturbations of the N and P cycles.

Concentration of chemical elements in marine ecosystems

Hazardous chemicals accompany the flux of other major elements from lower to higher trophic levels of the marine food web. Analyses of the chemicals contained in marine organisms such as zooplankton and squid have been carried out to evaluate the impacts of marine pollution.

Studies on the marine environmental changes by satellite and ship of opportunity

The distribution of the phytoplankton biomass is indicative of changes in the marine environment. We have developed and deployed a continuous biogeochemical monitoring system on a ferry line between Korea (Pusan) and Japan (Kobe). We found that low *p*H coincided with high p_{CO_2}, which is presumably caused by the biological decomposition of organic matter in the sediment.

Monitoring of coral reef changes by archiving of underwater images

Coral reefs are characterized by high gross productivity and biological diversity. They are vulnerable to environmental stresses such as siltation

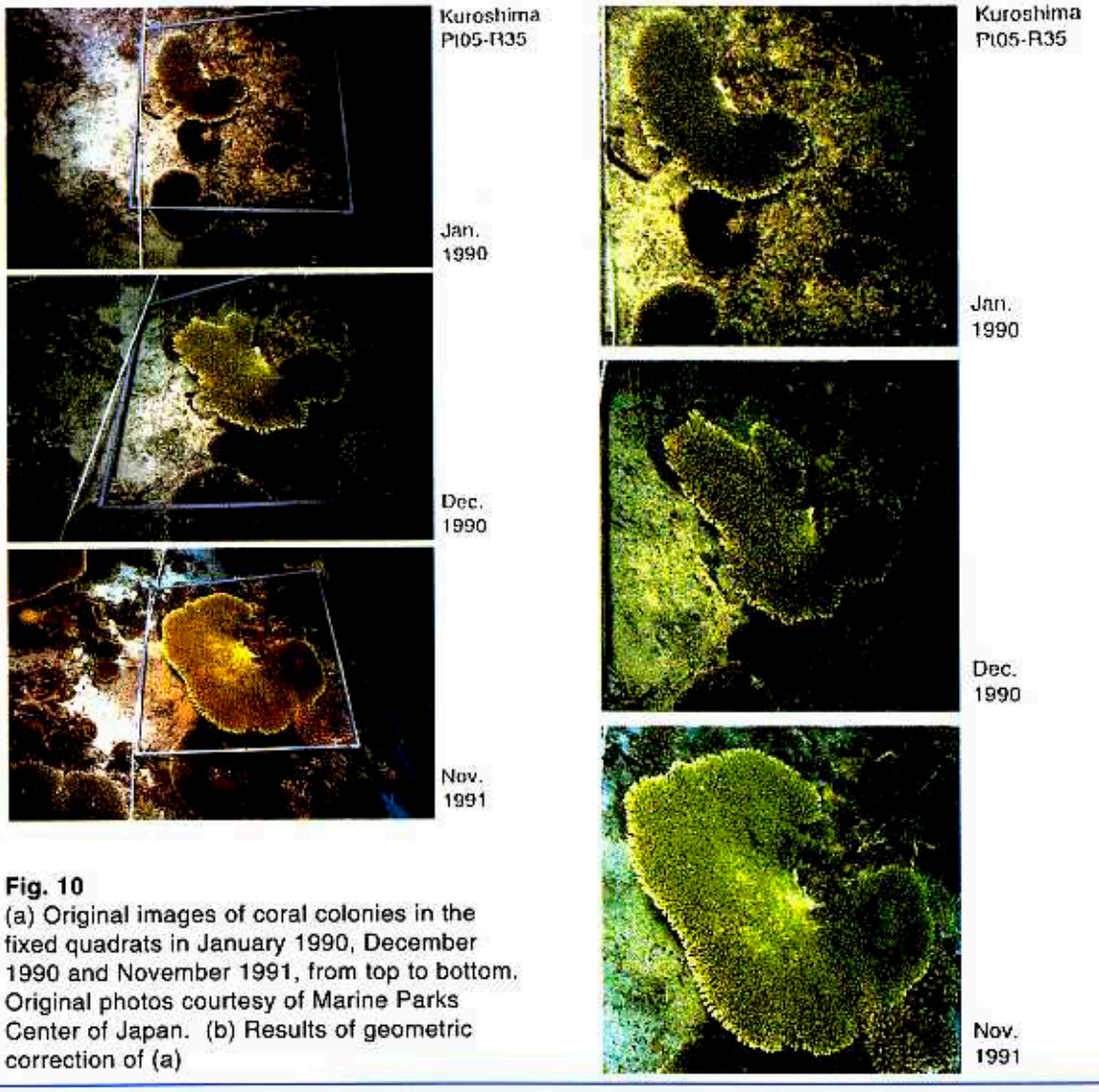


Fig. 10
(a) Original images of coral colonies in the fixed quadrats in January 1990, December 1990 and November 1991, from top to bottom. Original photos courtesy of Marine Parks Center of Japan. (b) Results of geometric correction of (a)

and waste water discharge. Recently it was reported that anomalously high water temperatures cause coral bleaching, i.e. the expulsion of endosymbiotic algae. This phenomenon sometimes leads to the deterioration or death of corals. We are developing a data acquisition system to monitor changes on coal reefs by taking underwater photographs by two methods: 1) yearly surveys of fixed stations marked with quadrats and 2) extensive surveys from a ship towing cameras. These images are being archived on CD-ROMs via geometrical correction algorithms. The photographic time series show coral colony growth and competition among species (Fig. 10).

Natural Vegetation Conservation Research Team

Studies on biodiversity in tropical forest ecosystems

Populations of canopy tree species in a forest are maintained through the process of gap regeneration. Gaps are created by tree falls. To determine how seedlings of different species respond to a canopy gap, the growth and survival of seedlings of two common dipterocarp species (*Shorea leprosula* and *Neobalanocarpus heimii*) in a forest gap and in a forest closed with a thick canopy were compared. The field experiment was done in the Pasoh Forest Reserve in Malaysia. At the gap, *Shorea* grew faster and had higher leaf turnover. Within a forest closed by the canopy, both species showed slow growth, but the survival rate of *Shorea* was lower (Fig. 11). There are temporal and spatial variations in light environments during the course of gap regeneration, which may cause suppression and enhancement of seedling growth. Regeneration of *Shorea* will be successful in a forest where the occurrence of gaps is

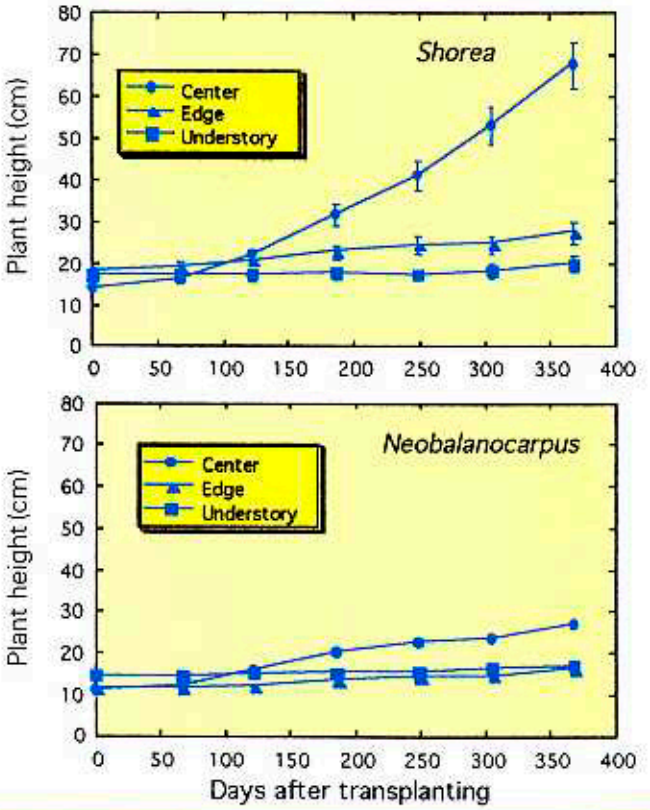


Fig.11
Height growth responses of two dipterocarp seedlings (*Shorea leprosula* and *Neobalanocarpus heimii*) to a canopy gap. *Shorea* showed higher growth at the center of the gap than did *Neobalanocarpus*. In the understory, both species showed very slow growth, but survivorship of *Neobalanocarpus* was much higher than that of *Shorea*.

relatively frequent, whereas *Neobalanocarpus* may regenerate at places where gaps are formed infrequently.

To understand the stability of tree populations in a lowland dipterocarp forest, various aspects of a data set obtained in a 50 ha plot of the Pasoh Forest were analyzed. The first aspect was an examination of the variation of sapling (>1, <2 cm in diameter) density as a function of distance from the nearest conspecific adult. The second analysis considered the relationship between the spatial distribution pattern of juvenile and adult trees. The last analysis evaluated juvenile recruitment and mortality. Of 466 species (for which more than 100 individuals each were recorded), the juveniles of 48 species were distributed with distance from the corresponding conspecific adult. Only 45 species had saplings which were aggregated while the adults were regularly or randomly distributed. For 411 other species, both adults and saplings showed aggregated distributions. For emergent species which can grow above the canopy of a forest, the number of newly recruited saplings of each species corresponded approximately to the number of dead saplings over the five year study period.

Interaction between desertification and human activities

The objective of this research is to evaluate the impact of biotic activities on desertification in arid and semi-arid ecosystems in India as evidenced by changes in vegetation, water circulation, soil and socio-cultural factors. Two grazing land sites in semi-arid and hyper-arid areas of the Thar desert in India were selected. The composition, cover, density, etc. of herbaceous species at each experimental site were studied in order to estimate carrying capacity. Land use and degradation were mapped using National Oceanic and Atmospheric Administration (NOAA) and LANDSAT data for these areas. A survey of awareness of desertification was undertaken at a village to understand the causal factors of desertification due to human activities. Four countries, India, China, Thailand and Kenya, were chosen for comparative study of desertification in relation to human activities. A minimum data set of information about desertification and land degradation was constructed to compare the causal factors of desertification in these areas. This data set contains climate, soil, water, vegetation, land-use and socio-economic variables.

Wildlife Conservation Research Team

Habitat fragmentation results in a reduction of the area of original habitat, a greater amount of edge habitat for a given total area and a reduced average distance to the nearest edge. The abundance of species is often low in edge areas but high in core areas. A dung beetle, *Sisyphus thoracisus*, is the most abundant species (constituting about 30% of total individuals trapped) among 38 dung beetle species so far recorded

in the Pasoh Forest. This species has two distinct generations each year and breeds mainly in core areas. A small forest consisting of only edge habitat might not support this type of species.

A long-term, large-scale census of small mammal populations was carried out in three types of forest: primary, secondary (selectively logged in the 1960's) and seasonal water-logged forests in Pasoh. Seventeen species of small mammals, including rats, squirrels and tree shrews, were recorded during two-years of monthly trapping. The abundance of each species was different among the three habitats. Rats were trapped with equal frequency in both primary and secondary forest, while squirrels were less abundant in the secondary forest than in the other forest types. The lower frequency of squirrels in secondary forest may be due to a shortage of large trees which produce large amounts of fruit. A forty year period after logging such forest may not be long enough for full recovery of small mammalian communities.

A decrease in the genetic variability of a wildlife population may lead to a corresponding decrease in fitness. Fitness can often be measured as fluctuating asymmetry (FA), however FA may be influenced by both genetic factors and environmental stresses. We examined the effect of density on the growth and FA of a fish (*Oryzias latipes*). Density affected the average growth rate but not FA, suggesting that a genetic factor plays a larger role in the mediation of FA than do density (environmental) effects.

Satellite Remote Sensing Research Team

This team has been leading the promotion of the Improved Limb Atmospheric Spectrometer (ILAS), Retroreflector in Space (RIS) and ILAS-II projects for atmospheric monitoring from space and also conducting fundamental studies on future satellite remote sensing techniques.

The ILAS and RIS instruments will fly on the Advanced Earth Observing Satellite (ADEOS) spacecraft in 1996 and ILAS-II will fly on ADEOS-II in 1999. Both ADEOS satellites will be launched by the National Space Development Agency of Japan (NASDA). The Satellite Remote Sensing Research Team is responsible mainly for the scientific aspects of the ILAS and ILAS-II projects. They are also responsible for management of ILAS, ILAS-II and RIS projects at NIES.

Studies related to these projects include instrument performance verification experiments, algorithm development for data processing, software development for the ILAS & RIS Data Handling Facility (DHF), validation experiment planning and management, development of data analysis techniques and satellite data application studies. The

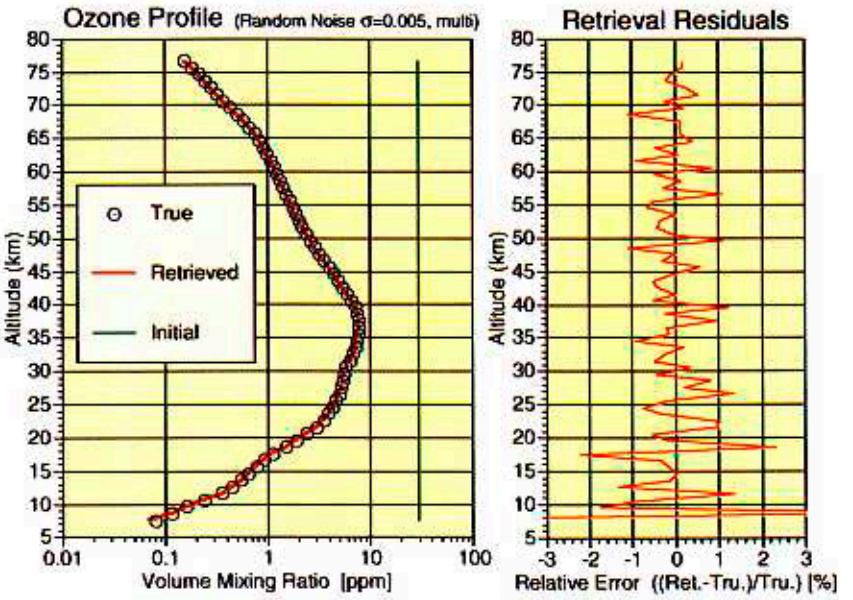


Fig. 12
An example of an ozone profile retrieved from a simulated ILAS signal.

ILAS & RIS DHF is being established in cooperation with the Center for Global Environmental Research (CGER).

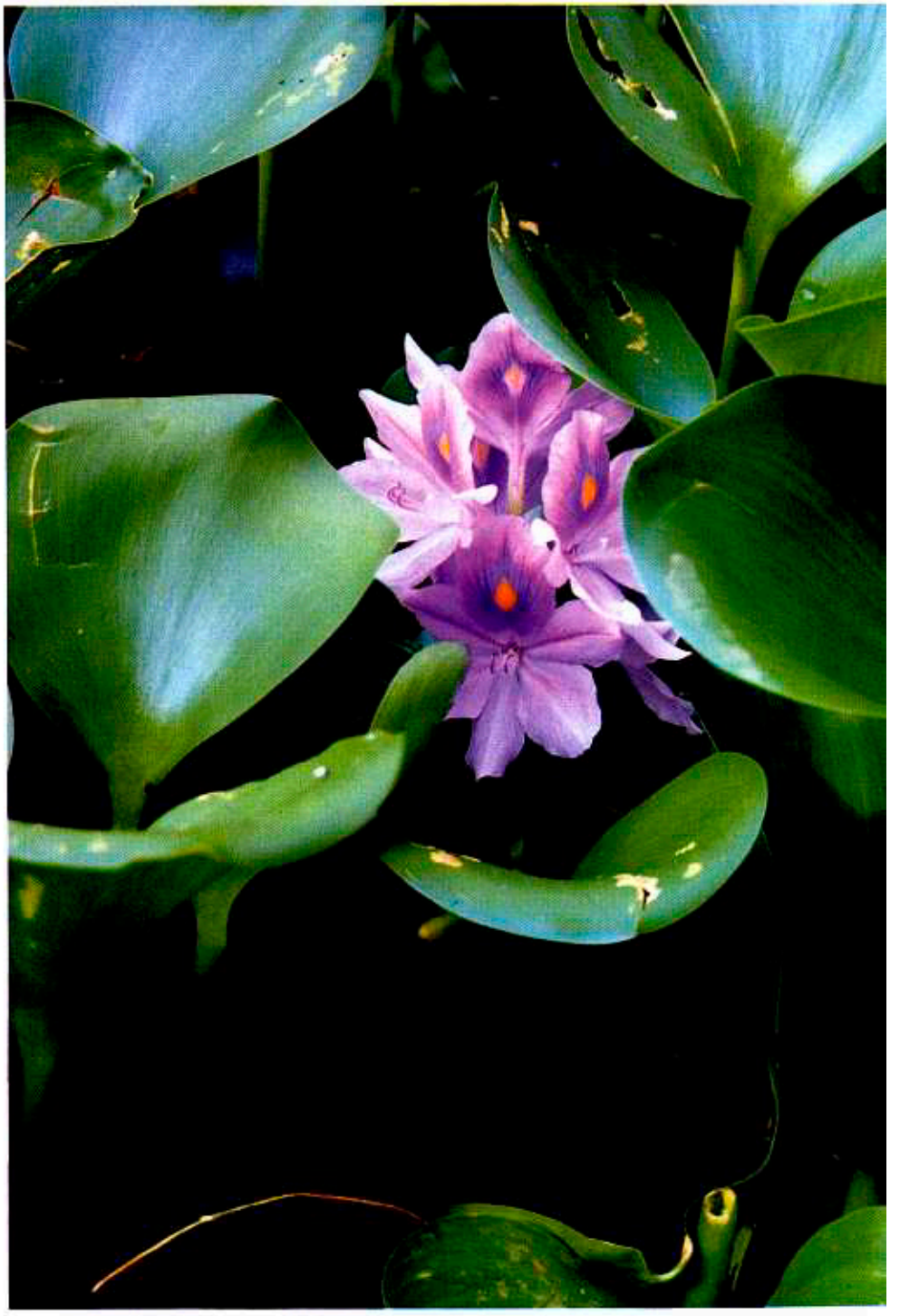
In order to retrieve gas profiles from data streams from the ILAS low spectral resolution infrared spectrometer, sophisticated algorithms and detailed knowledge of instrument function will be necessary. Instrument function was determined by instrument performance verification experiments. An algorithm based on the forward method with multi-channel non-linear spectrum fitting was developed and implemented in operational software (Fig. 12).

This team has also conducted research on utilization of atmospheric remote sensing data from space and developed techniques for applying satellite data to the analysis of atmospheric dynamics and the chemistry of the stratospheric ozone layer.

As one possible future instrument, the Satellite Remote Sensing Research Team has been involved in basic studies of a High-resolution Limb Atmospheric Spectrometer (HLAS), which employs an echelle-type grating for resolving the solar spectrum with resolution on the order of 0.1/cm. A preliminary experiment was conducted to demonstrate its capabilities and the results were applied to the design of the echelle grating spectrometer of the ILAS-II instrument.

NIES, since its establishment, has had a long history of lidar (laser radar) studies. The Satellite Remote Sensing Research Team conducted studies on space-borne lidars to demonstrate development feasibility and their significance in atmospheric sciences.

Regional Environment Division



This division is a project research unit dealing with both national environmental issues and overseas environmental pollution problems. The unit is composed of thirteen research teams. Our 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, our environmental studies in developing countries have also started to promote the transfer of environmental technology. Following is a summary of the current studies of our respective teams. Not all of the Regional Environment Division's research projects are included in the present report. Research reports from our respective teams have been published separately and are available on request.

Traffic Pollution Control Research Team

This team primarily studies: 1) methodology for environmental impact assessment of traffic systems, in particular motor vehicles and 2) technology assessment of environmentally friendly alternative traffic systems, in particular electric vehicles. As a part of a special research project entitled "Air and water pollution in an urban area caused by changes in the environmental load and countermeasures against it", the team has continued to develop two kinds of motor vehicle air pollution simulation programs. The first of these programs is a microscale model for predicting the dispersion of automotive exhaust gas near complex urban roadways using numerical solutions of advection-diffusion equations by the finite difference method. During this fiscal year, the team succeeded in improving calculation speed and convergence of the model by adopting new algorithms. The second of these simulation programs is named the Regional Traffic Pollution Simulation System (RTPSS). RTPSS is designed to assess countermeasures which mitigate traffic pollution on an urban scale. By combining traffic volume assignment simulation with air pollutant dispersion simulation (Fig. 1), this system predicts the impacts of various alternatives including modal shifts, changes in road network design, traffic flow control, etc. The system was first applied to the Tokyo metropolitan area, and preparations for its application to the Osaka metropolitan area, for which a variety of field survey data on air pollution are available, are proceeding.

A new project entitled "Research of Road Vehicles to Mitigate Related Aspects of Environmental Pollution" related to road vehicle problems such as environmental damage, energy usage, accidents and congestion, began in 1994. The following research is being performed: 1) Development of an electric vehicle with new size reduction and solar cell technologies. 2) Development of a traffic collision prevention system which controls vehicles in response to driver commands and sensor input. 3) A multi-layered road design for decreased traffic

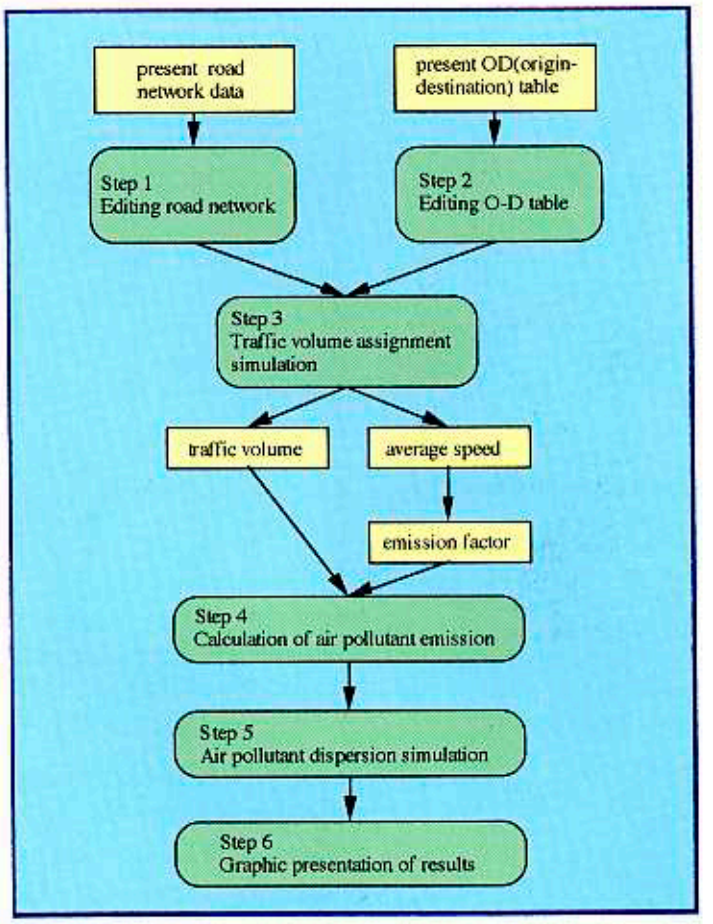


Fig. 1
Schematic diagram of the RTPSS

congestion. In addition, the life cycle amounts of energy consumption and CO_2 emissions required per unit of production of each good or service, have been estimated by the input-output analysis and summing-up approaches. Environmental loads for goods, services or facilities including motor vehicles have been evaluated by life cycle assessment (LCA).

Urban Air Quality Research Team

The major purposes of this research team were to investigate the formation mechanisms of NO_2, photochemical O_3 and aerosols in the urban atmosphere and 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 distribution. The program includes: 1) Air pollution trend analysis related to changes in the pollutant loading from various sources, 2) Field and wind tunnel studies of the dynamic behavior of urban air pollution and 3) Studies of an air pollution model and its application to urban areas.

High concentrations of NO_2 are often observed in winter under stable atmospheric conditions, but in the Kansai area, NO_2 concentrations also increase in spring. An intensive field survey of the Kansai area with aircraft was conducted in April 1993 to identify the source of high NO_2

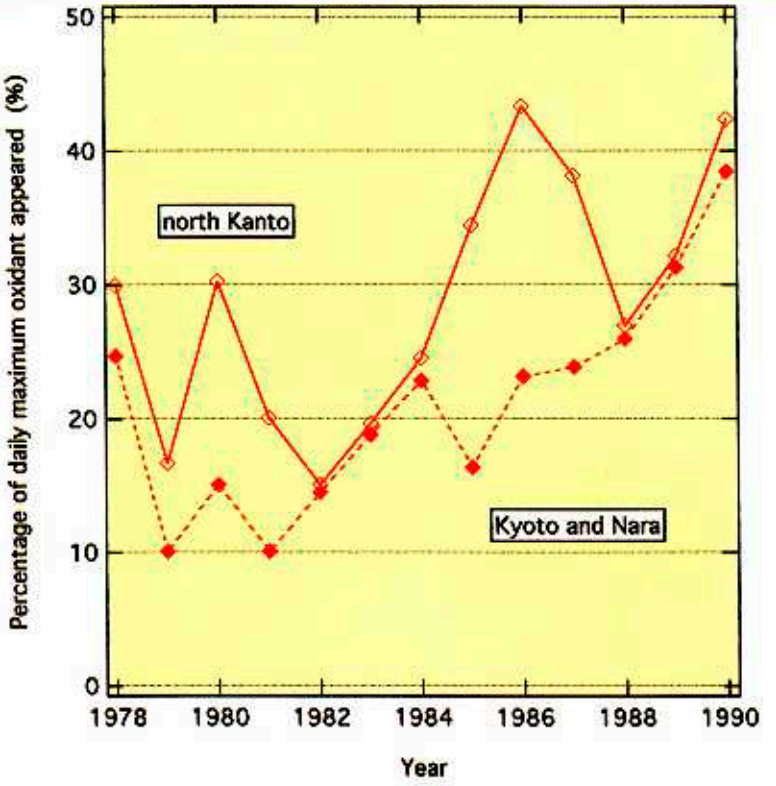


Fig. 2
Percentage of days on which the daily maximum oxidant concentrations in the two largest metropolitan regions were observed in North Kanto and in the Kyoto-Nara area (both remote from their regional urban centers, Tokyo and Osaka, respectively).

concentrations in spring. Analysis of three dimensional concentration data together with meteorological data revealed the importance of a photochemical reaction in spring. Air pollution trend analysis suggested a change in the mechanism of O_3 formation in summer in both the Kanto and Kansai areas. Recently regional O_3 maximum have been observed outside of the central Kanto and Kansai areas (Fig. 2). This trend of geographic widening of the urban oxidant concentrration maxima might be a reflection of the increases in NO_x emissions and decreases in the concentration ratio of volatile organic compounds (VOC) to NO_x which indicating on increase in O_3 formation potential and a decrease in photochemical reactivity, respectively. In addition to the above-described project research, the team has conducted research on urban air pollution model, on the similarity law for wind tunnel testing under thermally stratified flow and on technology assessment for the development of an Eco-house.

Coastal Environment Research Team

This team has studied the following two subjects with field surveys, laboratory experiments and mathematical models:

The evaluation and control of primary production increases due to eutrophication in an enclosed coastal area.

The ecological roles of heterotrophic dinoflagellates have been examined through laboratory culture experiments and field observations during the summer of 1994, when a red tide due to *Gymnodinium mikimotoi* occurred in the Seto Inland Sea. Following the outbreak, the abundance of a heterotrophic dinoflagellate, *Gyrodinium dominans*, increased

rapidly by ingesting *G. mikimotoi* cells and the red tide disappeared suddenly. The field observations are consistent with our laboratory culture results. Both sets of results indicate that heterotrophic dinoflagellates play an ecologically important role affecting the fate of primary production.

The effects of environmental changes on the constituents of marine ecosystems.

"Aoshio" or "blue tide" phenomena, which result from upwelling of anoxic water from the bottom of a bay to the sea surface, have been observed along the northeastern coast of Tokyo Bay during the summer season since the 1960's. These occurrence have attracted public concern because of both the unpleasant smell (mainly due to H_2S) and the death of fish and shellfish. Periodic observations have been conducted in the north-east sector of Tokyo Bay since 1989. Data on water quality parameters and some biological parameters were collected together with meteorological data. These data have been analyzed to develop a simple way to predict the occurrence of the Aoshio. Three conditions seem necessary for Aoshio formation: 1) the existence of anoxic bottom water, 2) a continuous north wind for two days and 3) a mean air-temperature decrease of 4°C or more in a day. Days with all three of these conditions coincided with 50 of the 54 days of Aoshio occurrence reported in the past 5 years.

An experimental study was conducted in the NIES bay simulator, which has a 4 m open channel and wind tunnel, to investigate upwelling and other vertical mixing processes in the bottom water under thermohaline stratification. The degradation of stratification by wind in the channel was very similar to that observed in Tokyo Bay. The upwelling flow patterns observed in the bay simulation were in good accord with numerical simulation results.

Lake Conservation Research Team

This team's main objectives have been to develop new indices for assessing the status of Japanese Lakes and their watersheds and also to investigate the regulation of phytoplankton succession in lake water. The targets for the new indices are as follows: 1) watershed indices related to organic matter and nutrient load generation potential, 2) lake water quality indices expressing the organic components especially with respect to origin and bio-degradability and 3) lake ecological indices describing the metabolic state of the lake water and sediments, and those depicting the degree of artificial disturbance. The mechanisms by which some phytoplankters such as *Microcystis* and picoplankton dominate lake phytoplankton communities have also been studied with particular reference to ecological interactions with other species and toxin production. The main results obtained in 1994 FY are as follows;

1) Statistical analyses were applied to water quality data obtained from nine watersheds, almost all of them forested and with different basin characteristics. Variables such as NO_3^--N, NH_4^+-N, DOC and dry weight have positive correlations with the proportion of the watershed which was eroded.

2) Bio-degradability tests of Lake Kasumigaura water samples confirmed that refractory dissolved organic matter (DOM) was produced by *in situ* biological processes in addition to that carried to the lake from the watershed (Table 1). We also found that the refractory DOM was mainly composed of small molecular-weight substances (<1000 Da).

3) The relationship between the ecosystem and nutrient cycles was investigated with different fish densities in six outdoor experimental ponds. The biological structure of these model ecosystems greatly affected not only the biological processes, but also the rate of nutrient cycling.

4) Through field surveys of picoplankton in Lake Nojiri and laboratory experiments on picoplankton growth characteristics, it was revealed that phycoerythrin-rich picocyanobacteria can grow even under irradiance levels as low as 1 $\mu E/m^2/s$. It was also found that the picocyanobacterium

Table 1
Summary of data on organic matter dynamics in L. Kasumigaura for October 1992 to September 1994 (n=24).

St.	DOC	UV	Fluo	Lignin	Carbohydrate	Protein
	mgC/l	Abs cm/l		mgC/l	mgC/l	mgC/l
1	2.76±1.04	0.065±0.029	29.7±12.9	0.10±0.05	0.47±0.27	0.94±0.34
2	3.00±0.83	0.065±0.021	29.1±10.3	0.09±0.03	0.46±0.20	0.87±0.35
3	3.19±0.71	0.065±0.017	28.5±8.2	0.09±0.04	0.47±0.19	0.83±0.33
4	3.38±0.38	0.062±0.012	26.8±6.3	0.08±0.03	0.44±0.11	0.75±0.31
5	3.43±0.40	0.064±0.010	27.8±6.4	0.09±0.05	0.44±0.16	0.87±0.39

St.	R-DOC; 40d	R-DOC; 100d	L-DOC	POC	Chlorophyll a
	mgC/l	mgC/l	mgC/l	mgC/l	µg/l
1	2.16±0.98	1.89±0.87	0.87±0.48	4.86±2.62	73.8±45.8
2	2.38±0.78	2.06±0.61	0.93±0.35	4.78±2.11	78.2±40.5
3	2.65±0.62	2.27±0.52	0.92±0.35	4.82±1.72	75.4±30.2
4	2.92±0.34	2.51±0.34	0.86±0.35	4.37±1.11	69.5±22.2
5	3.00±0.35	2.65±0.38	0.79±0.34	4.58±1.07	65.0±20.4

DOC, dissolved organic carbon; UV, absorbance at 260 nm; Fluo, Fluorescence, excitation at 260 nm, emission at 450 nm, relative concentration; Lignin: lignin or tannin-like compounds; R-DOC: 40d and 100d refractory DOC which remained after 40 day and 100 day-incubations, respectively; L-DOC: labile DOC which decreased during 100 day incubations; POC, Particulate organic carbon; River water flows down from St. 1 to St. 5.

Synechocystis sp. produces two kinds of neurotoxic compounds, spermidine and putrescine.

Wetland Ecosystems Research Team (Ad Hoc)

This team has studied the characteristics of wetland ecosystems and their resilience in the face of environmental change (FY 1991-1995). In co-operation with the Environmental Biology Division, we have explored the characteristics of mire ecosystems, the dynamics of their biological communities and their mechanisms of resilience. In FY 1994, research continued in Miyatoko and Akaiyachi Mires, in Fukushima Prefecture and in Kushiro Mire, in Hokkaido. In addition, a survey was started for Ozegahara Mire which stretches over the border between Fukushima, Gunma and Niigata Prefectures.

Observations of the meteorology, hydrology, flora and fauna were carried out in Miyatoko Mire. This mire was considered to be a fen (a mire fed primarily by waters from watershed areas) based on its water chemistry and hydrology, whereas the vegetation and zoobenthos had features characteristic of a bog ecosystem (a mire fed only by atmospheric precipitation).

Ozegahara Mire is a complex of bogs and fens. Zoobenthos and plankton communities in 25 pools in Ozegahara Mire were investigated in relation to hydrology, water chemistry and morphology of the pools. The groundwater table and peat moisture in the mire were measured with piezometers and the time domain reflectometry method, respectively. Remote sensing data were obtained at the same time from an airplane equipped with a spectral imagery. The resulting data were compared with the moisture data in relation to the differences in vegetation. Peat soil moisture was 60-100% at sites covered with Sphagnum moss whereas it was as low as 20-50% at sites where arbors of plants such as *Rhus trichocarpa* or cinnamon fern were distributed (Fig. 3).

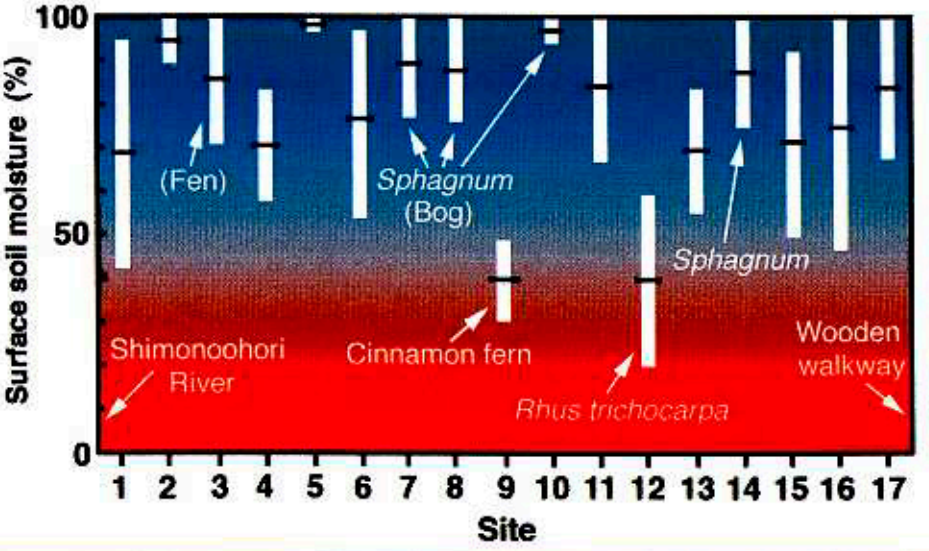


Fig. 3
Surface soil moisture measured by time domain reflectometry every 50 m along a transect line crossing the Ozegahara Mire at Nakatashiro. Maximum, minimum and mean values for five measurements are shown.

Akaiyachi Mire was surveyed with an electronic total station to clarify its topography. It is a dome shaped mire with its highest site in the northwest. The north and west margins of the mire are truncated by abandoned rice paddies. Peat soil moisture was lower near these margins.

Hazardous Waste Research Team

This team has started a new project to develop methodology to assess exposure to hazardous chemicals from waste landfills. Little is actually known about the environmental impacts of waste landfills in Japan. Our team, coordinated by the National Institutes for Environmental Studies and including fourteen local governments environmental research institutes, has been analyzing lanfill exudates. Twelve exudates and treated drainage fluids were sampled from seven different sites during late July and early August, 1994. The samples were gathered and homogenized in the National Institute for Environmental Studies and then distributed to the local governmental institutes for chemical analysis.

Measured items were general water quality variables such as temperature, *p*H, dissolved oxygen (DO), chemical oxygen demand (COD), biological oxygen demand (BOD), suspended solids (SS), nutrients such as total phosphate, reactive phosphate, nitrate, nitrite and ammonium, inorganic elements including both metallic and non-metallic elements and organic chemicals such as polychlorinated biphenyls (PCBs), polychlorinated naphthalenes (PCNs), pesticides, herbicides, plastic-additives including triphosphates and phthalates, polycyclic aromatic hydrocarbons (PAHs) and VOC.

The results are now being compiled and investigated. The preliminary findings include: 1) very low concentrations of highly hydrophobic compounds such as PCBs and some chlorine-containing pesticides, 2) high concentrations of some plastic-additives in some samples, 3) high concentrations of boron and arsenic in some samples. There was a broad range of concentrations of many of the elements analyzed (Table 2).

Table 2

Element concentrations in filtrates (0.45 μm membrane filter) of exudates from landfill sites.

	Element Concentration (mg/l)											
Sample	Al	As	B	Ba	Ca	K	Mg	Mn	Mo	Na	Si	Sr
1	0.40	<0.0005	1.4	3.7	730	1500	85	3.6	<0.05	4700	7.6	6.6
2	0.20	<0.0005	0.47	0.94	280	340	27	2.4	<0.05	1200	10	1.8
3	0.30	<0.0005	2.7	0.64	270	220	120	2.3	<0.05	1100	15	1.2
4	0.20	<0.0005	0.63	0.14	68	(8)	70	0.16	<0.05	59	24	0.66
5	0.47	<0.0005	0.64	0.45	370	31	44	0.89	<0.05	240	30	0.46
6	0.80	0.0008	1.1	2.6	980	1900	47	11	<0.05	3600	6.5	0.35
7	1.4	0.0022	5.9	1.8	1500	320	2.1	0.05	1.3	2500	5.4	16
8	6.2	0.274	30	0.22	130	63	0.4	(0.01)	3.3	620	4.3	4.4

A reference sample for contaminated soil was prepared for analytical quality assurance. Soil from a land-fill site was sampled. In order to avoid loss of organic constituents, the soil was sieved roughly through a nylon net, open-air dried, then dried in an electric drying oven at a temperature lower than 40°C and sieved through an 80 mesh screen. The sieved soil was then homogenized in a V-type blender and bottled in brown glass bottles. A homogeneity test and certification of the concentrations of constituents will be done in FY 1995.

Water Quality Renovation Technology Research Team

This team has studied soil and groundwater contamination with hazardous chemicals. The main goals of this research are to resolve mechanisms of the subsurface pollution and to develop feasible and cost-effective remediation technologies. Subsurface remediation including site investigation is very expensive, hence our ultimate goal is to optimize remediation schemes and to establish remediation systems which can restore the subsurface environment. With respect to organochlorine contamination, a pilot scale remediation system utilizing soil vapor extraction and groundwater extraction has been undertaken at one of the study sites contaminated with trichloroethylene to evaluate the effectiveness of the applied technologies. The results indicate that at the beginning of the remediation operation, soil vapor extraction is more effective at removing trichloroethylene by one order of magnitude as compared to groundwater extraction. However, groundwater extraction becomes more effective as the remediation progresses due to the changes in the subsurface environment. This change points out the importance, from the cost-benefit point of view, of implementing appropriate remediation strategies and, in particular of maintaining flexibility to change the remediation techniques corresponding to changes in the state of the contaminant in the subsurface environment.

In addition to organochlorine contamination, our team also analyzed the concentration of nitrate nitrogen in groundwater to estimate the nitrogen load from human activities such as agricultural practices, land application of sewage, etc. In particular, the nitrogen isotopic composition ($\delta^{15}N$) was measured to resolve the origin of the nitrate detected in regional groundwater. Cluster analysis of these results shows that the groundwater sampled from paddy fields could be classified into one group with nitrate nitrogen less than 10 mg/l, while groundwater from upland fields formed another group with concentrations greater than 10 mg/l. Furthermore, the nitrogen isotopic weight decreased with increasing nitrate concentration in the former group and they remained between 4.6 and 7.3‰ in the latter (Fig. 4). Such trends suggest that nitrate from chemical fertilizer applied to farm land may be leaching into groundwater.

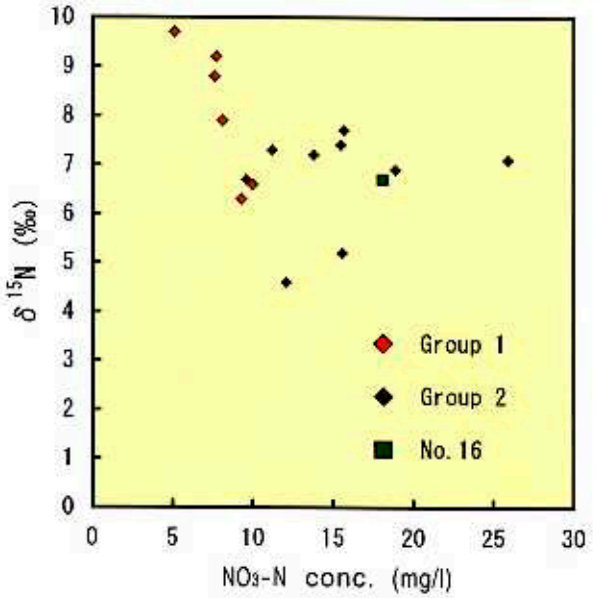


Fig. 4
Relationship between nitrate nitrogen concentration and isotopic ratio ($\delta^{15}N$).

Air Pollutants Health Effects Research Team

This team has studied the mechanism of pathogenesis and evaluation of the risk of chronic pulmonary diseases due to diesel exhaust. This study aimed to elucidate experimentally the causal relationships between diesel exhaust and respiratory diseases, established by epidemiology, and to evaluate the risks to human health from such pollutants.

Subthemes include: 1) Mechanisms of asthma pathogenesis and examination of the dose-response relationship between diesel exhaust and asthma. 2) Evaluation of the risk of pulmonary tumor formation due to diesel exhaust. 3) Evaluation of diesel exhaust exposure levels and their associated risks. 4) Evaluation of the risk of posed by diesel exhaust to human health.

FY 1994 research demonstrated that repeated intratracheal instillation of diesel exhaust particles (DEP) into mice induced marked infiltration of inflammatory cells, such as eosinophils and lymopocytes, and airway hyperresponsiveness. These are the most important of asthmatic symptoms. Furthermore, intratracheal administration of ovalbumin enhanced the symptoms with an increase of IgG1 in serum but without an IgE increase.

The effects of high dietary fat and β-carotene on lung carcinogenesis induced by DEP were investigated in male ICR mice. The incidence of lung tumors increased dose-dependently up to the 0.1 mg dose of DEP, but decreased at 0.2 mg. The incidence and multiplicity of lung tumors were enhanced by high dietary fat, whereas the incidence was significantly suppressed by dietary β-carotene (Fig. 5). These results suggest that oxygen radicals, a common factor in the conflicting effects of β-carotene and high dietary fat on carcinogenesis, may play an important role in DEP-induced carcinogenesis.

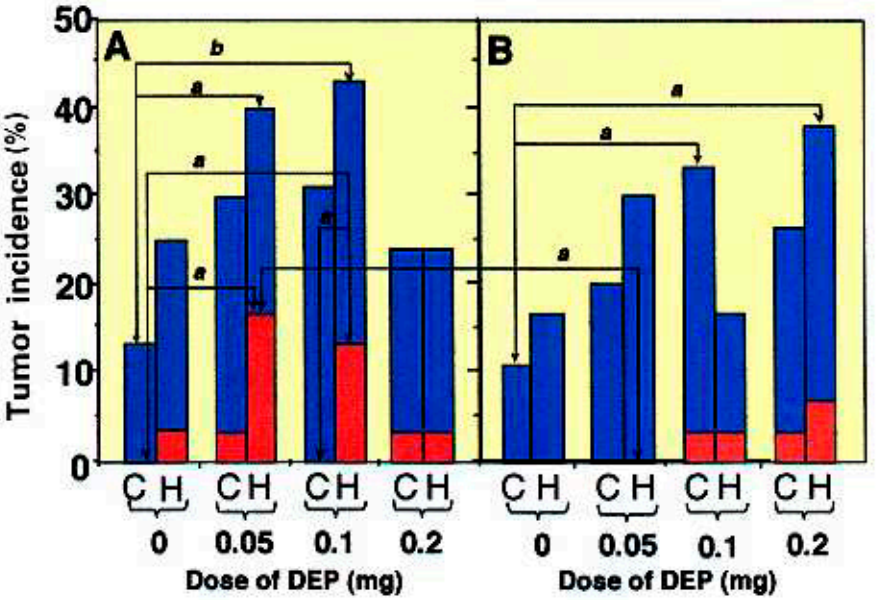


Fig. 5
Effects of high dietary fat and β-carotene on lung tumorigenesis induced by diesel exhaust particles (DEP).
A: non β-carotene supplemented group;
B: β-carotene-supplemented group.
C: 4% fat diet;
H: 16% fat diet.
■ : adenomas;
■ : adenocarcinomas.
a $p<0.05$, *b* $p<0.01$ (x^2-test).

The diesel exhaust initial inhalation exposure experiment was finished at the end of FY 1994. The onset of asthma and dose-dependency from that study are to be analyzed.

Chemical Exposure and Health Effects Research Team

This team has done research on exposure and human risk assessment of halogenated organic compounds. The purpose of this research is to systematically study halogenated organic compounds which have been released into the environment. Their fates and health effects through environmental exposures will also be studied. The following two major results were obtained in FY 1994:

1) Chlorinated organic compounds in urban river water and sediments were analyzed and their recent trends were studied. PCB was detected in the sediments of industrial areas. The concentrations of PCBs were related to the number of factories on both sides of rivers despite the fact that the use of PCBs was stopped 20 years ago (Fig. 6). In the sediments of residential areas, fungicides contained in soaps and shampoos, such

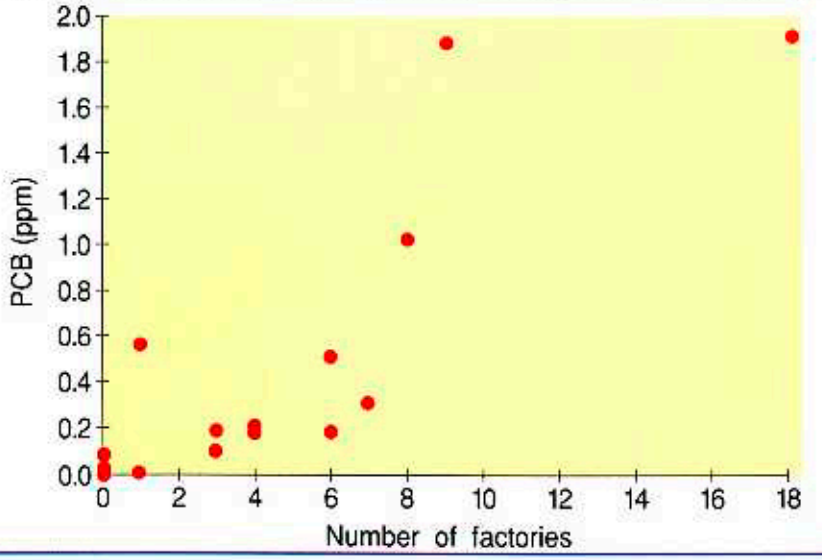


Fig. 6
The concentration of PCB in the river sediments of industrial areas and the number of factories on both sides of the rivers.

as triclosan or triclocarban, were the main chlorinated compounds. The concentrations of adsorbable organic halogen (AOX) in river waters were about 5 to 10 times those of organic halogens detected by GC/MS, implying that a large part of the AOX present comes from chlorination used for sterilization or bleaching.

2) The rat embryo limb bud cell culture (LBC) system has been employed as a teratogenicity screen on the assumption that chemicals which have specific action on cell differentiation are likely to have teratogenic potential. Tris (2-chloroethyl) phosphate (TCEP) showed relatively high teratogenic potential in LBC, and its embryotoxicity was further investigated in cultured whole rat embryos. TCEP showed significant effects on the protein content and morphological scores of embryos cultured for 44 hours at 3 mM.

Ecological Hazard Assessment Research Team

This team has studied the susceptibility of phytoplankton strains to a triazine herbicide, simetryn, in outdoor experimental ponds. All the strains isolated from the herbicide-treated ponds during the latter part of the experimental period were tolerant to 100 µg/l simetryn (relative yields: >70% of control), whereas all the strains isolated from the control ponds at the same time were susceptible (relative yields: <15%). *Scenedesmus gutwinskii* var. *heterospina* showed a marked difference in susceptibility between the strains isolated from the treated and control ponds (Table 3). These results indicate that changes in the genetic composition of the phytoplankton communities occurred when they were exposed to the herbicide.

The cladoceran *Daphnia pulex* was exposed to low oxygen concentration, a kairomone from the predator *Chaoborus* and the pesticide carbaryl and the combined effects of these factors on its life history characteristics were analyzed. These three factors reduced juvenile growth rate, mature size, clutch size and neonate body size, the effect of greatest consequence probably being the reduction in

Strains	LCL (µg/l)	EC_{50} (µg/l)	UCL (µg/l)
Isolated from the control pond			
C-1	10.5	16.9	27.2
C-2	11.3	16.1	22.9
C-3	8.6	16.0	29.8
C-4	9.4	14.8	23.2
C-5	9.9	22.3	50.3
C-6	11.3	16.3	23.6
Isolated from the low-dose pond			
L-1	189	587	1822
L-2	362	846	1975
L-3	378	690	1259
Isolated from the high-dose pond			
H-1	178	677	2576

Table 3
Simetryn EC_{50} values with the upper (UCL) and lower (LCL) limits of 95% confidence intervals for *Scenedesmus gutwinskii* var. *heterospina* strains isolated from the control, low-dose and high-dose ponds on day 57.

juvenile growth rate. Synergism of effects was detected with any pair of the three factors and with all three together, indicating that each factor reduces tolerance to the other factors.

Biotechnology Products Assessment Research Team

This team has studied the applicability of biotechnology to preservation of the environment and its risks. The approach is to produce transgenic organisms useful for preservation of the environment and to evaluate their influence in the environment. The results obtained in FY 1994 are as follows: 1) The glutathione reductase gene, which is assumed to be involved in resistance to oxidative stresses such as exposure to air pollutants, the herbicide paraquat, etc. was introduced into an aspen hybrid (*Populus sieboldii* × *P. grandidentata*). The transgenic aspen plants were more resistant to exposure to sulfur dioxide or paraquat than were non-transgenic control plants (Fig. 7). 2) Ozone-dependent ethylene production in tomato plants was confirmed and seems to play a critical role in the harmful effects of ozone. Ozone also enhanced the activity of aminocyclopropane carboxylic acid (ACC) synthase, a rate-limiting enzyme of the ethylene synthesis pathway. Two cDNA clones encoding ACC synthase were obtained from tomato leaves. 3) A plasmid pSR134 which contains *mergene*, a gene encoding enzymes which detoxify mercuric (II) chloride, was introduced into *Pseudomonas putida* PpY101. The plasmid was more stable in the microorganisms at 10°C than at other temperatures. 4) The survival of *P. putida* transformed with the *mergene* in soil and the effects of this transformed microbe on native soil microorganisms were examined.

In addition to the above mentioned research, the effects of UV-B irradiation on plants were studied. UV irradiation (290-310 nm) caused the formation of cyclobutane-type pyrimidine dimer (CPD) in the primary leaves of cucumber seedlings. Monochromatic light with

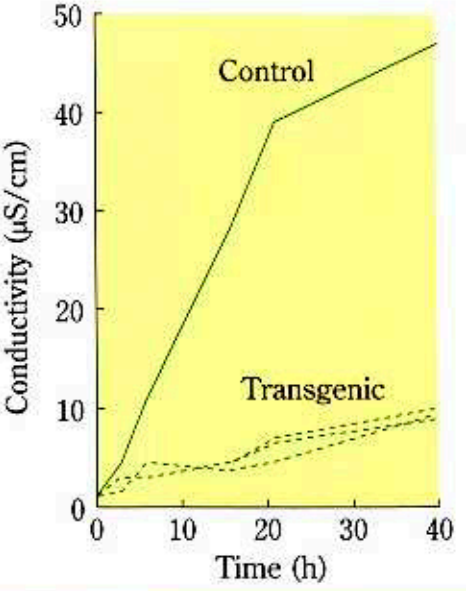


Fig. 7
Solute leakage from leaf discs of aspen plants exposed to paraquat. Leaf discs (7 mm in diameter) of aspen plants were excised and exposed to paraquat solution for 1 h in the dark, then transferred to distilled water, followed by illumination during the period indicated on the abscissa. The electric conductivity of the water was measured continuously.

wavelengths of 290 and 300 nm, particularly, 290 nm, effectively caused CPD formation. CPD formation paralleled the growth inhibition of cucumber primary leaves.

Urban Environment and Health Research Team

This team has studied the human health effects of urban environmental factors, particularly the effects of nocturnal traffic noise which has markedly increased in recent years, on sleep, as well as the suggested interactive effects of air pollution on sensitization to Japanese cedar pollinosis ("SUGI KAFUN-SHOU").

In an area through which major roads pass, 716 middle-aged women were surveyed with a questionnaire survey and their individual sound exposure during sleep was measured. Indoor and outdoor sound levels during sleeping time were significantly related and both were associated with functions of the nighttime traffic volume. The overall prevalence of the complaints: 1) difficulty falling asleep, 2) waking during sleep, 3) waking early and 4) felt insufficiently rested in the morning were 5.0, 3.5, 1.5 and 3.6 %, respectively. The amount by which these complaint rates were higher among participants living in the zone between 0 and 20 m from the roads relative to those for participants 20 to 50 m or more than 50 m away was proportional to the amount by which mean individual sound exposure levels during sleep differed in these three zones. Both complaint rates and sound levels were closely correlated with road traffic volume. The "minimum effective level" identified was 34 dB in Leq for "waking during sleep", suggesting that this type of complaint is the most sensitive indicator of sleep disturbance due to nocturnal traffic noise. The results suggest that sleep is being affected in large numbers of roadside residents. Monitoring of and countermeasures against these noise-induced sleep disturbances, especially concerning their "aftereffects" related to work efficiency, risk of accidents and chronic stress are necessary.

The over-all prevalence of Japanese cedar pollinosis in the season of 1993 in five areas surveyed ranged from 17.8 to 24.4% but showed variations with age. The maximum rate was observed among study participants in their thirties and the rates declined with age for participants in their forties or older. The accuracy of the pollinosis diagnoses were confirmed by the consistency of ELISA-measurements of serum specific-IgE as well as total IgE. Annual changes and areal differences in the rates of prevalence seem to be largely dependent on pollen exposure and do not seem to have been affected significantly by air pollution, particularly diesel exhaust, at least at the population level. However one cannot deny the possibility that air pollution may have effects on sensitization to allergic disorders among younger populations, whose prevalence of allergic disorders has been increasing rapidly,

especially in urban areas of Japan. In addition to these epidemiologic studies, the team has been conducting cancer epidemiologic studies and neurotoxicant risk assessments.

International Water Environment Renovation Research Team

This team has studied eutrophication of lakes, reservoirs and rivers, and countermeasures against eutrophication, especially nutrient removal from wastewater using specific microorganisms. Annual variations in water quality in urban public water supplies and water quality prediction systems for urban areas were also examined. Increases in the total N/P ratio caused blooms of harmful, toxin producing picoplankton and blue-green algae in surface waters used for public water supply. Clearly further nitrogen and phosphorus removal are important for maintaining water quality. A new small scale advanced on-site domestic wastewater treatment system, "anaerobic biofilm filtration process with flow-rate adjustment" was developed to treat domestic wastewater. Another new treatment system using an aerobic, thermophilic process was developed to treat high strength organic wastewater from livestock farms, restaurants, etc.

The results of a eutrophication simulation model suggest that water quality may worsen with increases in population. The installation of small scale advanced on-site domestic wastewater treatment systems in urban areas would improve the water quality of enclosed water bodies such as Tokyo Bay and Lake Kasumigaura.

The use of bio-films for water treatment has also been developed. Such systems are used for domestic water treatment in industrialized as well as in developing countries such as Kingdom of Thailand, Republic of Philippines, etc. These processes are expected to efficiently decompose anthropogenic contaminants such as trichloroethylene or naturally occurring toxicants such as microcystins.

International Health Effects Research Team

This team has assessed the health risks associated with air pollution from coal burning in China and possible risk reduction strategies. International cooperative research on exposure assessment for both outdoor and indoor air pollution from coal burning started in Beijing, China. Preliminary results (Fig. 8) show elevated levels of atmospheric pollutants of combustion origin in both indoor and outdoor air. Furthermore, special attention is being paid to airborne fluoride pollution from coal since it has been reported that endemic fluorosis has been caused by coal burning. In 14 provinces, 18 million people are suffering from dental fluorosis and 330 thousand are suffering from skeletal fluorosis. This research group will assess exposure to fluoride and the incidence of fluorosis in those areas.

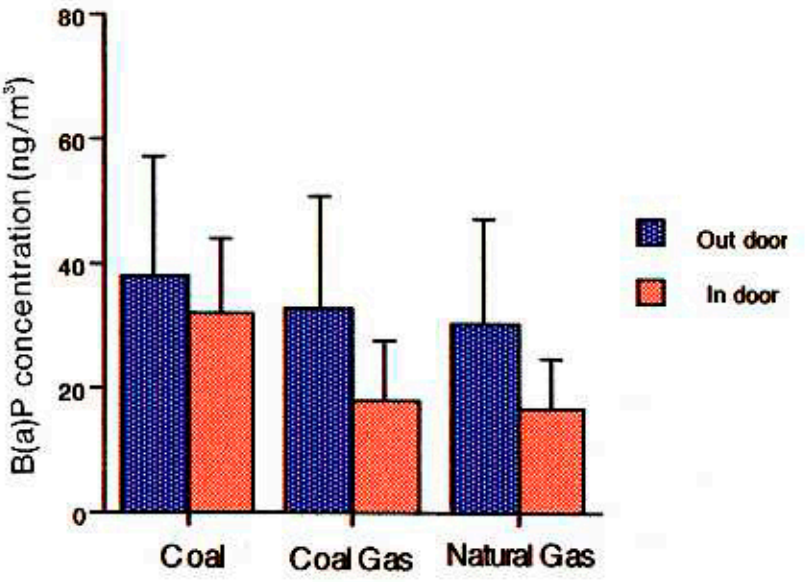
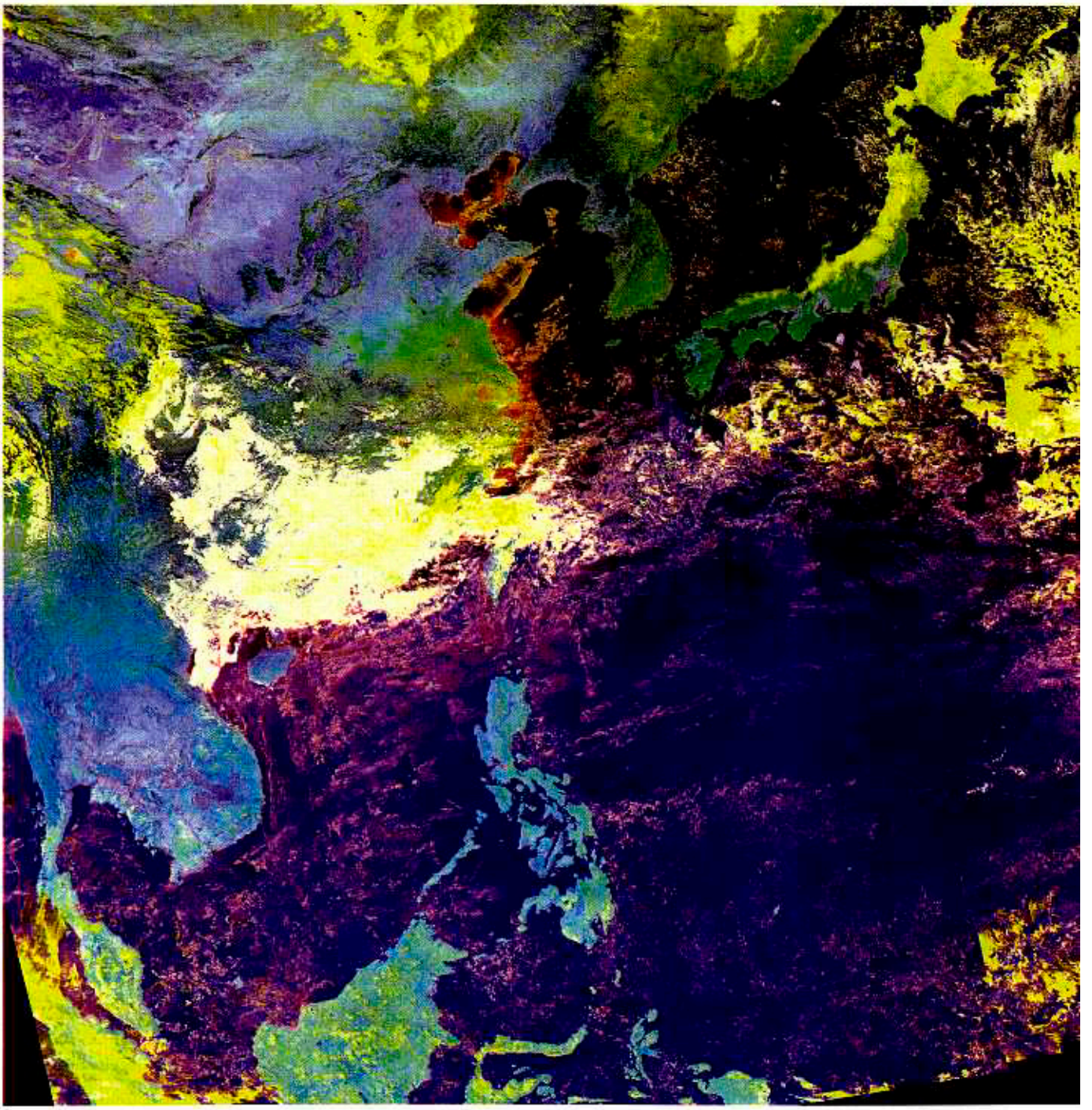


Fig. 8
The concentration of benzo-a-pyrene (B(a)P) in outdoor ■ or indoor ■ air in Beijing. (In the same winter season, the concentration of B(a)P in outdoor air along a main road in Tokyo is 2.25 ± 0.81ng/m³.)

Independently working scientists

In addition to the above 13 research teams, three independently working scientists are studying specialized subjects including environmental statistics, ecosystem preservation and environmental policy in developing countries.

Social and Environmental Systems Division



We define environmental problems as those resulting from environmental changes which are consequences of human activities, whether they be pollution, environmental degradation or destruction, and which in turn adversely affect or threaten human life, well-being and socio-economic activity. Therefore, the human and societal dimensions of environmental changes are of utmost importance for environmental protection and conservation. In this context, the Social and Environmental Systems Division concerns itself primarily with present and future interactions between social and environmental systems.

In FY 1994, the division, with its four units, the Environmental Economics (EE), Resources Management (RM), Environmental Planning (EP) and Information Processing and Analysis (IP) Sections, implemented the following eleven basic research projects:

(1) Socio-economic Analysis and Policy Assessment for Environmental Management (EE)
(2) Potentially Effective International Collaboration for Global Environmental Protection (EE)
(3) Impact of Environmental Policies on Economies (EE)
(4) Systems Analysis of Mass Transport Processes Associated with Water and Other Environmental Resources (RM)
(5) Recovery, Recycling and Reuse of Potential Resources for Waste Reduction and Their Impacts on Social and Environmental Systems (RM)
(6) Identification of the Structural Interrelationships of Environmental Planning Issues (EP)
(7) Methodologies for Surveys and Comparative Analysis of Environmental Perceptions (EP)
(8) Environmental Evaluation Methodology Based on Psychological Responses (EP)
(9) Information Processing Systems for Geographic and Image Data (IP)
(10) Modeling and Simulation Methodologies for Environmental Evaluation (IP)
(11) Preliminary Study of Methodology and Application of Life-cycle Assessment (RM)

Several selected issues were studied under research topic (1): a survey of consumers' life-styles and their perceptions of and attitudes towards environmental protection revealed that those who are active in environmental protection are more likely to have life-styles which are environmentally benign. The possibility of reducing CO_2 emissions by changing the life-styles of consumers was also researched. An

international comparison of people's environmental awareness was performed with the results of surveys of uniform design in several European countries and Japan. The National Industrial Input/Output Table was used to estimate the total life-cycle energy consumption and CO_2 emissions of selected industrial sectors, in the initial case, the automotive sector. Preliminary "industrial ecology" studies were performed to improve the effectiveness of already proposed instruments and methodologies in minimizing the environmental loading associated with industrial activity. These instruments and methodologies include environmental auditing and management for corporations, life-cycle assessment (LCA) for industrial processes and products and ecolabelling to provide consumers with environmental information.

Research topic (2) deals with policy science analysis and assessment with a model of the development and implementation of an international environmental convention. The Montreal Protocol on Substances Depleting the Ozone Layer and the Climate Change Framework Convention are two of the international agreements that were studied.

A computable general equilibrium model was developed as a component of research topic (3) to identify and simulate the effects of a carbon tax and other economic instruments, under consideration to control the emissions of greenhouse gases, on the macro economy. The reference case was specified, and based on this, the level of carbon tax to be imposed was calculated so as to stabilize emissions at the 1990 level.

Relevant data were collected to evaluate the impacts of local water resource consumption in the Lake Kasumigaura watershed on nutrient cycling and eutrophication in the lake itself under research topic (4) activities.

Research topic (5) concentrates on the development of LCA methodology for assessing the life-cycle resource and environmental impacts of processes and products which should be recycled. Several types of plastic and metal beverage containers were analyzed to establish our LCA model. The energy balance of a refuse incinerator with power generation was analyzed over its entire life-cycle.

The environmental awareness of the people living in an urbanized district, where residences and light industry were mixed, was surveyed in research topic (6) with particular reference to conflicts arising between the residents and factory owners. Several effective strategies for resolving conflicts of this type were obtained. These strategies may be effective in improving the incorporation of environmental considerations into urban planning.

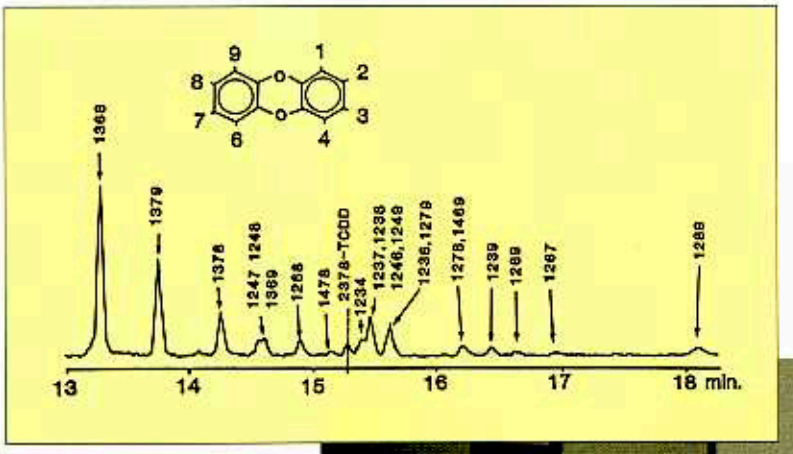
Research topic (7) is a basic methodology study for the development of effective environmental perception surveys. A free association method was developed. Several "stimulating" words are first presented to respondents, who then reply freely with stimulated concepts and ideas in words or phrases. Urban residents living near highways were compared with people living in other residential and industrial districts.

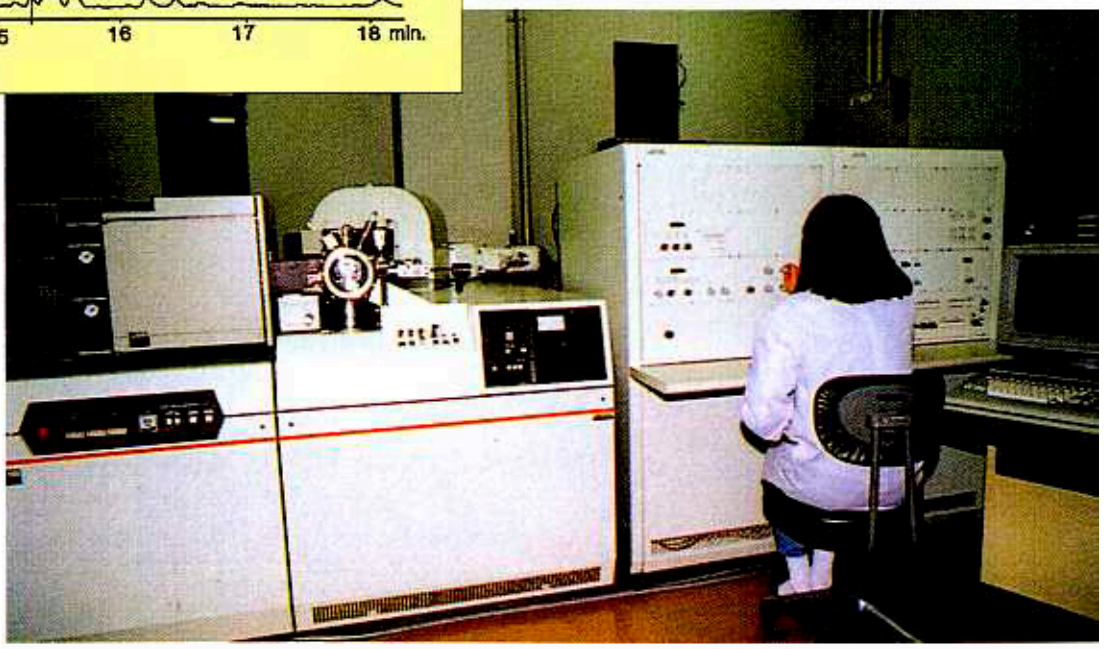
Under research topic (8), vegetational changes in Tsukuba Science City over the past decade were followed in photographs that have been taken repeatedly at the same angles at selected points in the city. Certain kinds of trees have been identified as important factors for evaluation of the landscape. Some descriptions of the local landscape from the diaries and travelogues of foreigners who visited during the Edo-Meiji Period were confirmed and many factors have been extracted to determine landscape value.

Developments under research topics (9) and (10) have produced improved image processing techniques for analysis of remote-sensing data such as those obtained from various earth observation satellites. Environmental changes in vegetation and land use were identified through analysis of such data. Models to quantitatively analyze and evaluate environmental changes were formulated and simulations based on these models were performed. Computational techniques that facilitate such simulations and presentation of the results were also developed.

Research topic (11) was a preliminary study of LCA for a Special Research Project which will begin in FY 1996. An extensive scientific literature survey was completed on the subject. Conventional LCA studies are largely inventory analyses. Few of these dealt with impact analysis based on inventory data. A draft research design was proposed for the following years.

Environmental Chemistry Division





Analysis of chlorinated dibenzodioxins in atmospheric particulates (upper) by a high resolution gas chromatograph/mass spectrometer (below)

Research in this division provides bases for environmental measurement—analytical instrumentation, methodology and quality assurance. The division also conducts research on the fate and toxicology of chemicals, with the aim of better understanding the behavior and hazards of chemicals in the environment. Because of these broad approaches, the 15 research projects which have been conducted through FY 1994 in our ordinary research program concern a wide range of environmental problems. Members of the division actively participate in programs organized by the project-research divisions, particularly in four projects in the Global Environment Division and in three projects in the Regional Environment Division. Activities have been extended to include three joint research programs in collaboration with prefectural environmental institutes and two projects subsidized by the Science and Technology Agency.

In the **Analytical Instrumentation and Methodology Section**, development of mass spectrometry for environmental analysis has been a major concern. A new conditional air sampler to accurately measure the flux of terpenes emitted from forests, which play an important part in the global carbon cycle and in atmospheric carbon chemistry, has been designed and constructed. A program to develop a system to detect DNA-toxic chemical adducts with high sensitivity has been initiated. The adduct would be an appropriate biomarker for assessing carcinogenicity or genotoxicity of chemicals.

Studies on standardization and quality assurance in environmental chemical analysis have been continued in the **Analytical Quality Assurance Section**. The program to collect standard data and to construct a database for GC/MS identification of chemicals is now approaching its initial goal. Using this database, a GC/MS search system has been implemented on personal computers. Volatile aldehydes that are malodorous components from heat-treated fish flesh have been identified and quantified.

The **Environmental Chemodynamics Section** focuses mainly on chemical state analysis and its application to the elucidation of the fates of chemical substances in the environment. The development of chemical chronology using the yearly changes in the chemical composition retained in various environmental samples has also been one of the main concerns of this section. Previously we have shown that marine pollution with organotin compounds such as tributyltin (TBT) causes malformation of the sexual organs in gastropod females (a so called 'imposex'). Now a survey of the possible effects of organotin contamination on abalone has been started.

In the **Chemical Toxicology Section**, studies on chemical structure and toxicity of both natural and anthropogenic toxic compounds have been continued. Toxins produced by blue-green algae and the mechanisms of

their toxic action on the mammalian liver have been evaluated. A bioassay system which studies the effects of gaseous substances on cultured mammalian cells has been developed. Dose-response relationships have been obtained for volatile organohalogen compounds.

The environmental certified reference material (CRM) program was in its fifth year of preparing and certifying reference materials of defined chemical speciation. Preparation of "Scallop (Adductor Muscle)" (NIES CRM No. 15) has been completed and an interlaboratory cooperative analysis is underway to establish the certified values for the concentrations of inorganic and organic arsenics. "River Sediment" (NIES CRM No. 16) has been prepared. The concentrations of important polycyclic aromatic hydrocarbons in this CRM are to be certified. The activities carried out during 15 years of environmental specimen banking and related research programs have been summarized (Y. Shibata ed., Environmental Specimen Banking—Fifteen Years Experience in NIES—, F-77-'95/NIES, in Japanese, 1995).

Preliminary paleoenvironmental studies of Lake Baikal sediment cores have demonstrated the feasibility of conducting research as an international joint project starting in 1995 and funded largely by the Science and Technology Agency. This project constitutes an important part of the Baikal International Center for Ecological Research (BICER) established under the initiative of the Russian Academy of Science. Brief accounts of some of the important 1994 outcomes from the division are as follows:

Seasonal variability of halocarbons in the high arctic troposphere

Weekly average concentrations of four natural halocarbons (bromoform, dibromochloromethane, bromochloromethane, chloroiodomethane) and three anthropogenic halocarbons (trichloroethylene, tetrachloroethylene, and *trans*-1,2-dichloroethylene) were measured at Alert (82.5°N, 62.3°W), in the Canadian high arctic, from January 1992 to June 1994. Air samples were collected on Tenax TA adsorbent and were analyzed with capillary

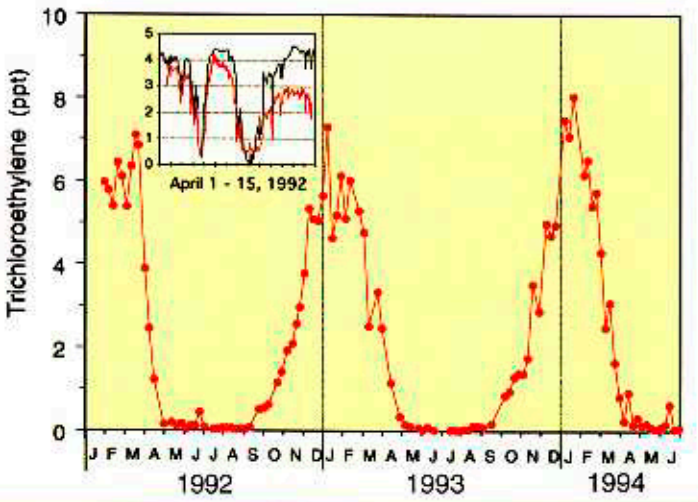


Fig. 1
Weekly average trichloroethylene concentration at ground level at Alert. Inset is the hourly trichloroethylene concentrations (solid line) and ozone (broken line) during the Polar Sunrise Experiment '92 (April 1-14, 1992).

GC/MS using selected ion monitoring (SIM). The winter/summer concentration ratios of trichloroethylene (Fig. 1), *trans*-1,2-dichloroethylene and chloroiodomethane were 60, >10 and >7, respectively, and extremely low concentrations were observed in summer for each compound. The winter/summer trichloroethylene concentration ratio was as much as 60, one order of magnitude higher than that observed in a remote area of Japan, where the winter value was only twice as high as that observed during summer. This observation that the amplitude of the seasonal variation of trichloroethylene is much greater in the arctic than in Japan is consistent with the greater distance of Alert from anthropogenic sources at mid-latitudes which allows the compound there to degrade more completely under attack by hydroxyl and other radicals. The winter/summer concentration ratios of the three bromomethanes suggest that some of the summertime decrease of bromoform and dibromochloromethane are also likely to be caused by chemical loss in summer. Chloroiodomethane, which may be a very important source of atmospheric iodine in addition to the contribution of methyl iodide, showed a very significant seasonal variation. The biggest difference between chloroiodomethane and other reactive halocarbons is that its decrease starts in early February before that of the other compounds. This suggests that it reacts photochemically much more rapidly than do the other marine-derived halocarbons.

Sensitive detection of DNA adducts by HPLC/MS/MS

We are identifying suitable high performance liquid chromatograph (HPLC)/mass spectrometer (MS)/MS conditions for sensitive and selective detection of DNA adducts. Various columns and volatile buffers have been tested to separate benzene nucleotide model adducts prepared by the reaction of benzoquinone with nucleotides (Fig. 2). Good separation was not obtained with any column run with neutral ammonium acetate buffer. An inert octadecylsilane (ODS) column, which showed relatively good separation, was selected to investigate the mobile phase conditions. Among the various

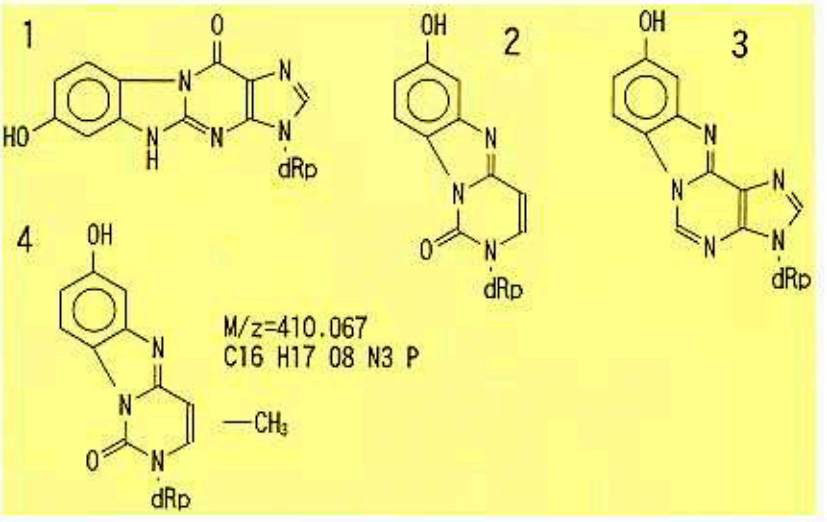


Fig. 2
Structures of benzene nucleotide model adducts (1, 2, 3) and methylcytidine adduct (4).

buffers/ion pair reagents evaluated, ammonium hydrogen carbonate buffer resulted in good separations. Performance of three HPLC/MS interfaces, namely frit fast atom bombardment (frit-FAB), atmospheric pressure chemical ionization (APCI) and electrospray ionization (ESI), have been investigated by using nucleotide solutions . ESI was sensitive, but unstable, and was not sensitive with buffers. APCI was not sensitive. Frit-FAB was capable of stable operation under the HPLC conditions for benzene model adducts with 0.2-0.3% glycerol as the FAB matrix. Reaction solutions for the synthesis of benzene model adducts, which contain 10^{-6}~10^{-5} g/ml of the model adducts, were successfully analyzed by HPLC/MS/MS. Unknown minor adducts were detected during the experiment. A small peak detected from a reaction solution for the cytidine model adduct was identified as a methylcytidine adduct based on accurate mass measurements and the MS/MS spectrum. HPLC/MS/MS has been demonstrated to be a useful tool for research on DNA adducts. However, further application of this method to, for example *in vivo* samples, will require improvements in sensitivity by using micro HPLC, new stable ESI, etc.

High resolution inductively coupled plasma (ICP) mass spectrometer

The instrumentation design and performance of a high-resolution ICP mass spectrometer for resolving inter-element spectral overlaps have been investigated. A high resolution of 43,000 was obtained by using a double-focusing magnetic sector mass analyzer coupled with an ICP ionization source through a three-stage differential evacuation system and a Q-lens. Resolution of isobar overlaps was demonstrated for Se-76/Ge-76 and Sm-150/Nd-150 at a 1 ppm concentration level (Fig. 3).

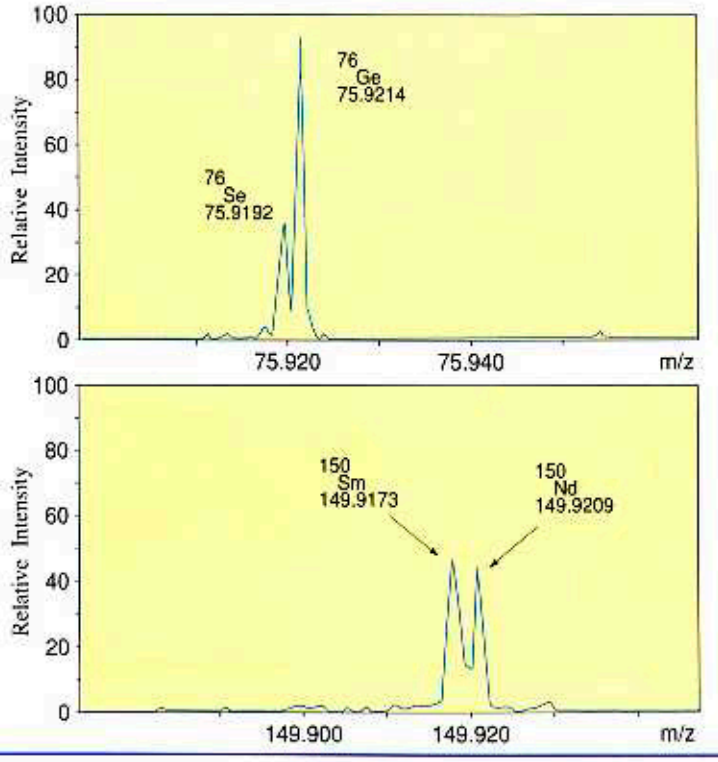


Fig. 3
High-resolution ICP mass spectra at a resolution of 40,000: (upper) Se and Ge solution each at 1 µg/ml; (lower) Sm and Nd solution each at 1 µg/ml.

Leachates from landfills

The concentrations of tris (2-chloroethyl) phosphate (TCEP) in leachates from landfills for hazardous wastes were determined selectively by wide-bore capillary gas chromatography using flame photometric detection. Mean recovery through all procedures was 99%. The relative standard deviation was around 9% and this fairly high value might be due to fluctuations in the flame photometric detector. The detection limit was calculated to be 67.5 ng/l based on statistical analysis. A clean-up procedure using silica gel column chromatography has been effective for aqueous samples containing large amounts of organic materials. Concentration levels of TCEP ranged from 0.137 to 5.43 mg/l. The origin of TCEP seems to be waste plastics. No TCEP was detected in either ground water or tap water.

Arsenic speciation

The speciation of elements (identification and quantification of each chemical species) has attracted much interest because the toxicity and environmental fate of an element changes considerably depending on its chemical form. A combination of HPLC with ICP mass spectrometry provides a versatile and quite sensitive way to speciate elements including arsenic. Arsenobetaine, a non-toxic, ubiquitous organoarsenic compound which accumulated in marine fishes, crustaceans and mollusks, was identified rigorously for the first time as the major arsenic compound in both blood cells and sera of men who ate fish (Table 1). This fraction should be differentiated from other arsenic fractions which might represent the level of exposure to toxic arsenic from environmental sources. The concentration of arsenobetaine in blood cells was higher than that in sera, indicating that the compound is easily absorbed by cells and transported through the blood stream. Information on the distribution of arsenic compounds in the environment and analytical methods for arsenic including its speciation have been compiled (Y. Shibata and M. Morita, Arsenic and organoarsenicals, Anal. Contam. Edible Aquatic Resour., VCH Publ., pp159-173, 1994).

Elemental composition changes in annual banding structures of calcareous tissues in animals

Hard tissues of biological origin, such as fish otoliths, shells, corals and teeth, are interesting because they grow constantly with an annular layer/

Volunteer	1	2	3
Sex	Male	Male	Male
Age	29	31	39
AB in plasma	3.3	—	0.9
AB in serum	4.6	1.6	1.7
AB in cell lysate	10.1	—	5.7

Table 1
Arsenobetaine (AB) concentrations in human blood (ng As/cm^3)

ring structure in which the amounts of elements/isotopes are affected by the ambient environment at the time of formation. Secondary ion mass spectrometry (SIMS) is a quite sensitive and reliable method for microelemental/isotopic analysis. Using a FAB-SIMS technique, periodic changes in several elements, including Sr, along a fish otolith were revealed. The changes coincided well with the visual annual banding structure, suggesting that the patterns are related to changes in environmental variables such as temperature. A portable drilling system to recover long coral cores from living microatolls was constructed. This system was used to obtain samples in Australia in collaboration with Australian scientists (supported by STA funds). The analysis of samples is now underway.

Chemical structures and biological activities of algicidal compounds

Blooms of toxic cyanobacteria (blue-green algae), including *Microcystis*, have been detected in freshwater lakes all over the world. *Microcystis* has often been involved in poisoning of animals, but has also been implicated in human health problems. Water supplies contaminated with toxic cyanobacteria are often treated with copper-based algicides. However, copper is also toxic to fish and zooplankton at concentrations above 0.01 ppm. For these reasons, it is necessary to develop toxic cyanobacteria-selective algicides which are nontoxic to fish and other organisms. During investigation of algicidal compounds in micro-organisms, we identified a novel cytotoxic carbohydrate-conjugated ergosterol (astasin) (Fig. 4) isolated from cells of the colorless euglenoid, *Astasia longa*. Astasin accounted for about 2.4% of the total lipid of the euglenoid cells. Astasin was composed of one equivalent each of ergosterol, α-D-xylopyranose and oxalic acid. Its structure, 2,3-oxalyl-α-D-xylopyranosyl(1$\rightarrow$3') ergosterol, was identified by FAB-MS, derivatization, and ^{13}C and ^{1}H nuclear magnetic resonance spectrometry (NMR). When cells of HL 60, a human lymphoma, were cultured with astasin, 50% of cell growth was inhibited at 5.0 µg astasin/ml medium, while cell growth was completely inhibited and 50% of the initial cells were killed at 10.0 µg astasin/ml medium. Astasin also inhibited the cell growth of toxic *Microcystis* at a concentration of 25 ng/ml.

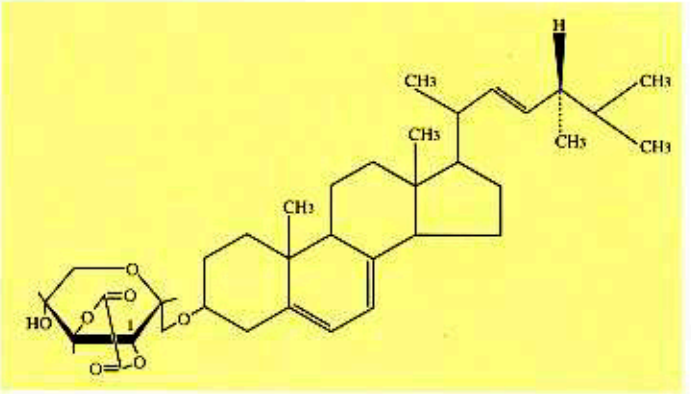


Fig. 4
Chemical structure of astasin.

Environmental Health Sciences Division

The main scope of this division's research activities covers experimental and epidemiological studies of risk assessment for environmental agents which are harmful to human health. Among the agents we study are nitrogen dioxide and diesel exhaust particulates (DEP), toxic chemicals, heavy metals, Japanese cedar (sugi) pollen, ultraviolet radiation and noise. The severity and manifestation of health effects as well as the development of detection and assessment methodology are considered to be the primary research themes of this division. Depending upon the distribution of a given agent in the environment and its possible health effects, research topics are classified into either domestic or global environmental issues. Research objectives which were considered to be domestic and global environmental issues have been pursued as research projects or programs supported by the Global Environment Research Programs or Special Research Programs, in collaboration with scientists belonging to Global Environment and Regional Environment Divisions.

During fiscal 1994 we performed 14 regular Research and three Special Encouragement Research programs. These studies are of a more or less fundamental nature and their disciplines are toxicology, biochemistry, immunology, physiology, pathology, epidemiology, human ecology and other related environmental health sciences.

Experimental studies were performed in three sections; the Biochemistry and Physiology Section, the Experimental Pathology and Toxicology Section and the Biological and Health Indicators Section. In addition, studies that dealt with human populations were carried out in the Environmental Epidemiology Section.

Among the studies of the effects of environmental factors on organs or the whole-body were anoxia due to air pollution and its effects on respiratory and circulatory functions, the effects of air pollutants on the circulatory and ventilation systems using isolated lung tissues, the development of an *in vivo* NMR method to evaluate rodent brain, liver and muscle function and the relationship between heat stress and immunological function in rodents.

Several experimental studies evaluated the cellular basis of responses. These included research on chemotaxis and activation of inflammatory cells, the proliferation and differentiation of mast cells, interactions between various types of cells which comprise alveoli and the development of a neurotoxicity assay using primary cultured neurons.

We have also studied the genetic/molecular basis of toxicity by exploring how genes are affected by both heavy metals, such as mercury and cadmium, and organic toxic compounds, such as PCBs. In addition, we have started using transgenic mice to study the molecular aspects of toxicity.

The following investigations and field surveys of human populations have been performed: the development of methodology to estimate individual exposures to suspended particulate matter; the possible use of payment records of the National Health Insurance System as a health indicator; the relationship between nasal allergies and environmental factors such as air pollution and Japanese cedar pollen; the relationship between weather and mortality; assessment of the impact of noise by sleep disturbance analysis.

In Japan, the number of patients with allergic diseases, such as allergic rhinitis caused by Japanese cedar pollen, has been increasing considerably. Epidemiological studies have suggested that this recent increase in allergic diseases is related to exposure to environmental pollutants. DEP have been observed to be a modulating factor in the onset of allergic disease. The relationship between DEP and allergies is being explored by evaluating the steps in immune response or in the responding cells which are modulated by environmental pollutants and induce allergic responses. In this annual report we describe, in greater detail, a few topics which are related to the immunotoxicology.

Gangliosides as T cell activation or differentiation markers

T cells play a pivotal role in regulating immune response. There are two well-known subsets, helper- and cytotoxic-T cells. Recent studies revealed that when cloned, helper T cells can be further categorized into at least two subpopulations, Th1 and Th2 cells. *In vivo*, naive helper T cells are thought to differentiate into Th1 or Th2 cells under the influence of some combination of cytokines after activation by antigen and antigen presenting cells. These two populations show distinctive patterns of cytokine production and effector functions. In the process of IgE antibody production, Th2 cells induce differentiation of IgE plasma cells from B cells by secreting interleukin 4 (IL-4) (Fig. 1). Th1 cells, on the other hand, suppress IgE production through

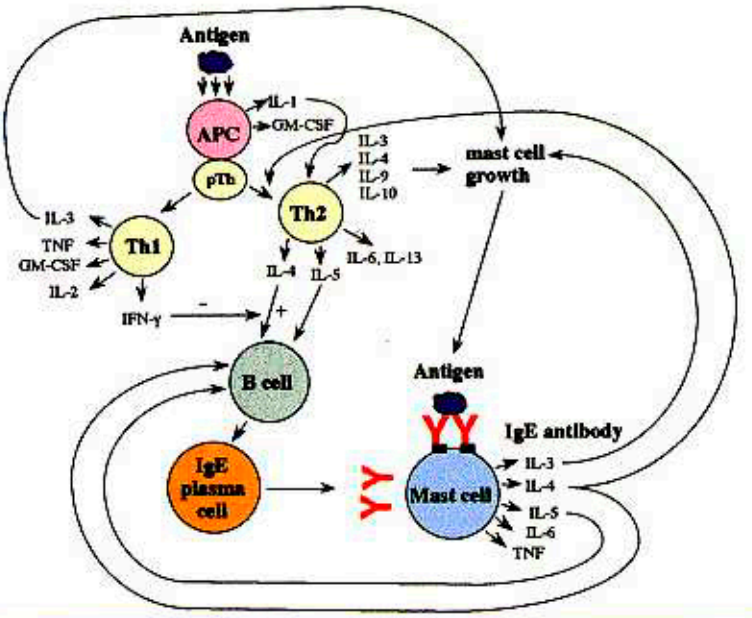


Fig. 1
Role of inflammatory cells and cytokines in allergic reactions
APC : antigen presenting cell
pTh : progenitor T-helper lymphocyte
Th1 : T-helper-1 lymphocyte
Th2 : T-helper-2 lymphocyte

the production of interferon (IFN)-γ. Thus in allergic response, each activated T cell subpopulation functions differently. To analyze the induction of allergic response, cell surface markers for these T cell subpopulations should be very useful, although such markers are not yet fully available.

Gangliosides are complex glycosphingolipids which consist of a lipid moiety (ceramide) to which is attached an oligosaccharide chain containing one or more neuraminic acid derivatives. They are present in plasma membranes and known to be involved in cellular differentiation. Experimental evidence that gangliosides also are associated with T cell activation and proliferation has been accumulating. It is thus plausible to propose that gangliosides are useful markers for lymphocyte growth and differentiation.

To establish new ganglioside markers for each T cell subpopulation differing in its level of differentiation, we studied the structures of lymphocyte gangliosides in two rat lymphatic organs, the spleen and thymus. Our studies have shown that the B cell gangliosides isolated from rat spleen consist mainly of those synthesized through the pathway from GM3 to GM1. Three novel gangliosides with the GM1 core and the extended modification, α Gal-LacNAc-GM1, α Gal-$(LacNAc)_2$-GM1 and sialyl-LacNAc-GM1, which we isolated from rat spleen and characterized in the course of this study, were also found in the B cell fraction.

In contrast, T cells isolated from rat spleen contained GD1c (NeuGc,NeuGc), a unique ganglioside synthesized through asialo-GM1 (GA1), as the predominant ganglioside. In addition, three other GA1-derived gangliosides were detected in T cells and identified as GM1b (NeuAc), GM1b (NeuGc) and GD1α (NeuAc,NeuAc). In thymocytes which consist mainly of immature T cells, GD1c was the predominant ganglioside. Thus, the gangliosides derived from GA1 were identified as singular components of T lineage cells. As the amount of GD1c in splenic T cells was much higher than that in thymocytes, GD1c may be associated with T cell maturation. These unique gangliosides in T and B cells may serve as markers for the differenciation of each lineage, or of some subpopulations.

Furthermore, in our study GD1c in rat thymocytes increased considerably upon stimulation. In addition, another ganglioside, which was barely detectable in resting thymocytes, was shown to increase to a level similar to that of GD1c. We isolated this ganglioside and characterized it as a rare species of GD1b, GD1b (NeuGc,NeuGc) (Fig. 2). A recent study by another group suggested that a functional similarity exists between Th1 cells and GD1c positive cells. This possibility will be clarified by further studies. GD1b (NeuGc,NeuGc) may also be a new type of specific marker to distinguish another subpopulation of activated T cells.

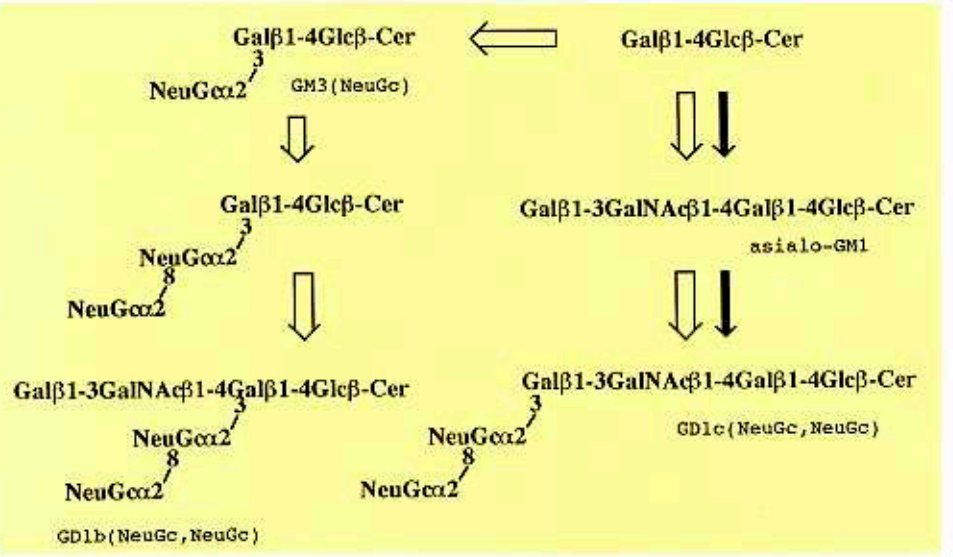


Fig. 2
Major pathways of ganglioside synthesis in rat thymocytes before (solid arrow) and after (clear arrow) activation. The boldface arrow indicates that the resulting gangliosides were present in large amounts.

Effects of ganglioside GM3 on mast cell differentiation

Ganglioside GM3 has a role not only in suppressing cell growth but also in inhibiting ligand-stimulated phosphorylation of growth factor receptors. Mast cells are involved in allergic response as well as in immune regulation (Fig. 1). Previously, it has been reported that ganglioside GM3 has an inhibitory effect on natural killer cell cytotoxicity and an enhancement of T suppressor cell activity. Moreover, inhibition of interleukin 2 (IL-2) and 4-dependent T cell proliferation occurred upon addition of exogenous GM3.

We examined whether exogenous GM3 modulates the growth and characteristics of interleukin 3 (IL-3)-dependent bone marrow derived mast cells (BMMC). In the presence of IL-3, increasing concentrations of GM3 decreased the number of BMMC which had been cultured for two weeks in a dose dependent manner. Although the addition of IL-4 to the culture medium increased the number of BMMC, treatment with GM3 reduced IL-4's proliferative activity. In contrast, the total histamine content of BMMC cultured with GM3 increased markedly.

To investigate the effects of GM3 on BMMC cell membrane, the expression of IgE receptors was measured by particle concentration fluorescence immunoassay. BMMC which had been cultured for three weeks were treated with GM3 for one week. GM3 significantly increased the expression of IgE receptors on these BMMC (Fig. 3). The mechanism of action of GM3 on the BMMC cell surface remains unclear.

To examine the functional changes in BMMC treated or nontreated with GM3, BMMC which had been cultured for three weeks were treated with GM3 for one week. The production of tumour necrosis factor (TNF)-α

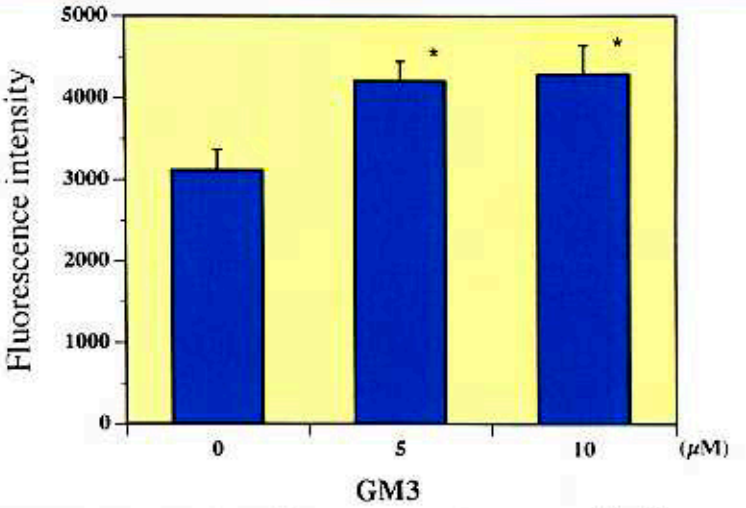


Fig. 3
Expression of IgE receptors on BMMC cultured with GM3. Three-week-cultured normal BMMC were cultured with 0, 5 and 10 μM GM3 for 1 week. The fluorescence intensity (arbitrary unit) of IgE receptors on the membrane surface of BMMC was measured by particle concentration fluorescence immunoassay.

from BMMC cultured with L929 as a target cell was quantified by enzyme-linked immunosorbent assay. Treatment with GM3 suppressed the production of TNF-α by BMMC. TNF-α is a key cytokine of inflammation and a host defense response to injury or neoplasia. It is likely that GM3 may play a role in disturbing host defense mechanisms.

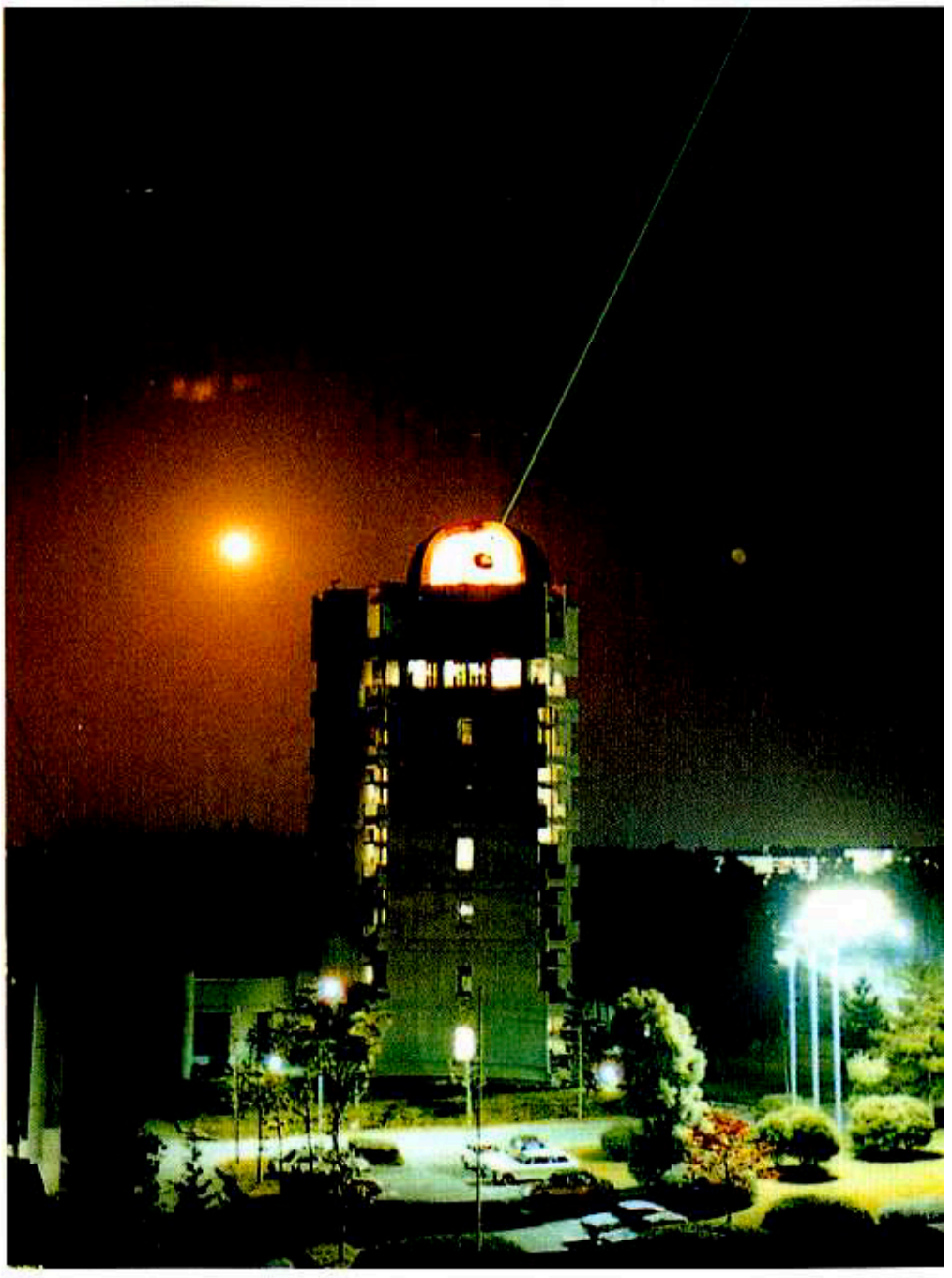
Cytokine production in mice intratracheally instilled with DEP and antigen

The enhancement of IgE antibody production induced by air pollutants such as DEP and fly ash might be related to their effects on cytokine production.

To explore the relationship between enhanced IgE antibody production and the effects of DEP and local cytokine production, mice were intratracheally instilled with DEP and ovalbumin (OA) 3 times at an interval of 3 weeks. One week after the last intratracheal instillation, the *in vitro* proliferative response of the mediastinal lymph node cells was four times higher in mice instilled with DEP plus OA than in those from mice instilled with OA alone. The production of both IL-2 and IL-4 was enhanced in mediastinal lymph node cells from mice instilled with DEP plus OA. Moreover, the anti-OA IgE titers of sera from mice instilled with DEP plus OA were higher than those from control mice.

These results suggest that the enhanced antigen-specific IgE antibody production in mice intratracheally instilled with DEP plus antigen is related to the increases in proliferative response and IL-4 production via T-lymphocyte activation in mediastinal lymph node cells. Recently, a reciprocal relationship between IL-4 and IFN-γ in the effects of DEP was demonstrated in cervical lymph node cells from mice intranasally instilled with DEP plus OA. The mechanisms of enhanced IL-4 production in mice to which DEP and antigen were administrated were not evaluated. One possibility is that macrophages, which engulf DEP and release interleukin 1, were modulated. Further data are required to determine whether DEP induces cytokine release from antigen presenting cells.

Atmospheric Environment Division



The Atmospheric Environment Division conducts basic studies on the distributions, properties and reactions of atmospheric pollutants, as well as on related tropospheric and stratospheric chemistry and physics. The division consists of four sections, the Atmospheric Physics, Chemical Reaction, Upper-Atmospheric Environment and Atmospheric Measurement Sections. Several facilities such as a photochemical reaction chamber, lidar (laser radar), ozone lidar, aerosol chamber and wind tunnel are available in cooperation with the Global Environment and Regional Environment Divisions.

Atmospheric Physics Section

The Atmospheric Physics Section focuses its research on the analysis and numerical modeling of atmospheric dynamics. Analysis of the global climate system with a climate model (atmospheric general circulation model) and observational data, in particular, is a main research topic to facilitate the study of both global (global warming, destruction of stratospheric ozone, acid rain, etc.) and regional scale environmental issues.

Global climate system modeling

The global climate system is being analyzed with a climate model and observational data. A high-accuracy and high-efficiency general circulation model (GCM) developed through joint research with University of Tokyo is used intensively. Preliminary numerical experiments were performed with realistic boundary conditions. The GCM we developed is compatible with most of the advanced models in the world in that our model's results are similar to observations (Fig. 1). A series of GCM experiments was performed to explore the dynamics of the temporal distribution of precipitation and Hadley circulation in low-latitude areas. These experiments revealed that one essential component of these dynamics is convergent flow in the planetary boundary layer, which is driven by the sea surface temperature gradient. Chaotic Lagrangian motion and heat transport processes have also been examined with the ten year running output of the GCM. Improvements to/validations of the GCM especially focused on stratospheric dynamics, gravity wave propagation and land surface parameterization, are in progress.

Tropical cumulus convection system analysis

The interaction processes between tropical cumulus activity and large-scale atmospheric dynamics were studied by analyzing meteorological satellite data and numerical studies with the GCM. Theoretical equatorial wave modes in the tropical cloud fields and the characteristic values of atmospheric waves associated with cloud activity were analyzed.

Mesoscale atmospheric modeling and land surface - atmosphere interaction research

Land surface processes and the mesoscale atmospheric transport/diffusion

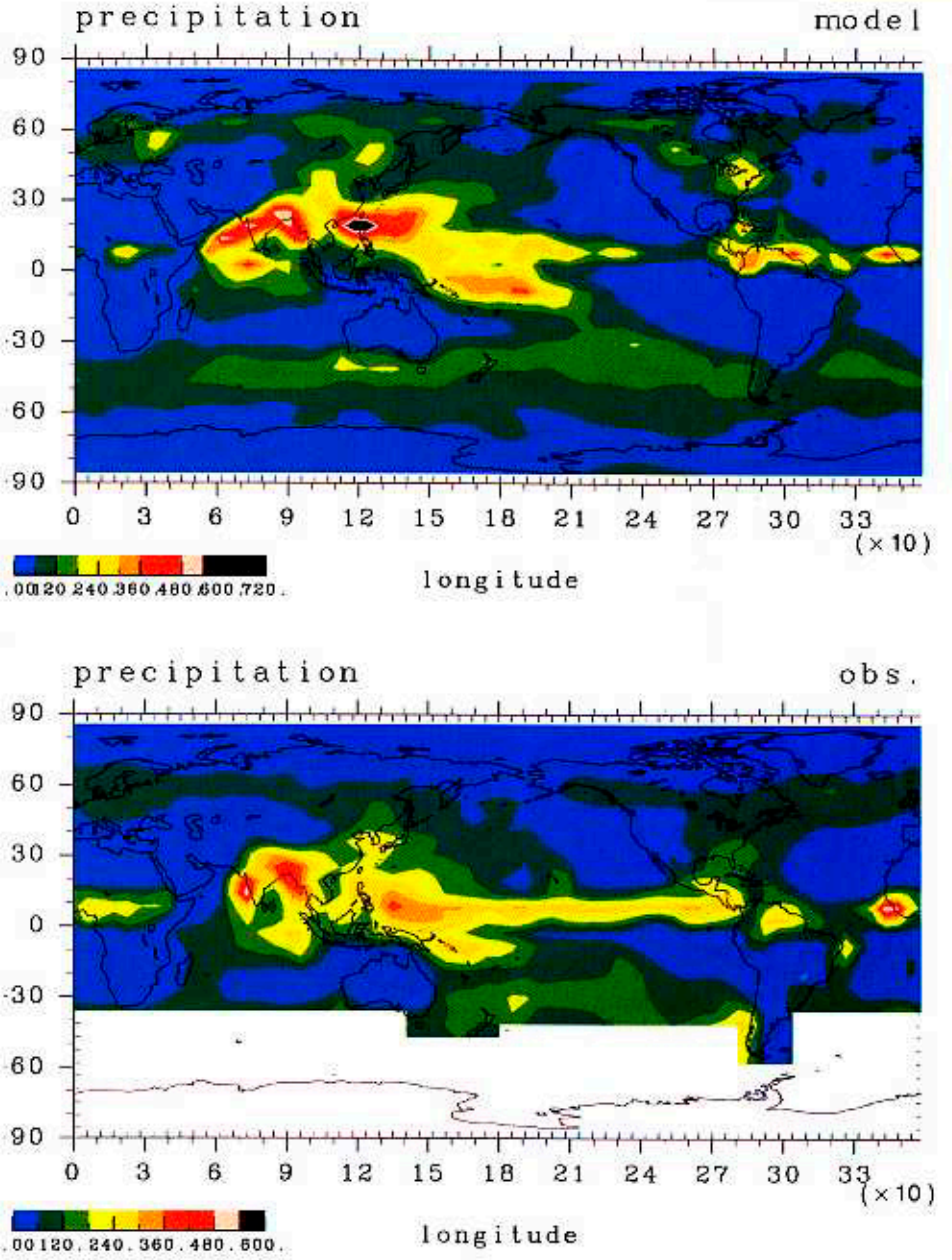


Fig. 1
Global precipitation in July. Model (upper panel) and observations (lower panel). Contour interval is 60 mm/month and shading indicates regions with more than 120 mm/month of precipitation.

processes are being studied with the Colorado State University Mesoscale Model (CSU-MM) and Regional Atmospheric Modeling System (RAMS). A mesoscale numerical model simulation using four-dimensional data assimilation (FDDA) was also conducted to quantitatively evaluate the complex airflow over the Kanto region. The model results were validated with data from a special three-dimensional observation program carried out over the Kanto region. The numerical model simulated the daytime sea breeze penetration and convective boundary layer development. However, the model flow under stable atmospheric conditions, particularly at night,

is slightly different than that observed. An atmospheric transport model including chemical reactions is also being developed and has been used to evaluate the transport/transformation processes acting on atmospheric components passing through the China-Korea-Japan region.

Basic research on land surface-atmosphere interactions including vegetation and hydrological processes has been carried out to improve land surface parameterization. A one-dimensional atmosphere-land model has been developed. The sensitivity of the long term heat and water exchange processes at the ground surface to bottom boundary conditions in this model is being investigated to improve the land surface scheme for climate models in general. The results suggest that the treatment of the soil bottom boundary should be considered more carefully than has been done in conventional schemes.

Numerical studies on stratified and rotating flows

A numerical study of the internal gravity waves excited by an obstacle in the flow of a linearly stratified Boussinesq fluid has been analyzed. The solution of the Navier-Stokes equation agrees well with the solution of Grimshaw and Yi's results, revealing that the latter is a good model of nonlinear internal waves excited in a linearly stratified Boussinesq fluid. A numerical study of the three-dimensional internal waves excited by topography in the flow of a stratified fluid is in progress.

Chemical Reaction Section

The chemical reaction section deals with the photochemical and thermal reactions of a relatively small number of reactive atmospheric constituents. Studies on the photochemistry and kinetics of free radicals related to photochemical smog, acid deposition and the fates of airborne chemicals in both the troposphere and stratosphere have been carried out.

Experiments in a 6-m^3 photochemical reaction chamber

Ozone destruction by CFC's ($CFCl_3$ and CF_2Cl_2), BFC's (CF_3Br and $C_2F_4Br_2$), HCFC's (CH_3CCl_2F, CF_3CHCl_2, and CF_3CHFCl) and CH_3Br was demonstrated in a 6-m^3 evacuable photochemical reaction chamber equipped with UV-enhanced Xe arc lamps. Decay of ozone via a catalytic cycle involving Cl or Br atoms released by UV-photolysis of halocarbons was evident although the chain length was far shorter than that in the real stratosphere (Fig. 2). Due to the limitation of space in the chamber, the chain length of the catalytic cycle was 8 for $CFCl_3$ and 40 for CF_3Br. Rates of ozone decomposition were faster with BFC's than with CFC's. These results can be explained by the efficiencies of the BrO + BrO and the ClO + ClO reactions.

The OH radical-initiated photooxidation of isoprene has been investigated experimentally in the 6-m^3 photochemical reaction chamber equipped with

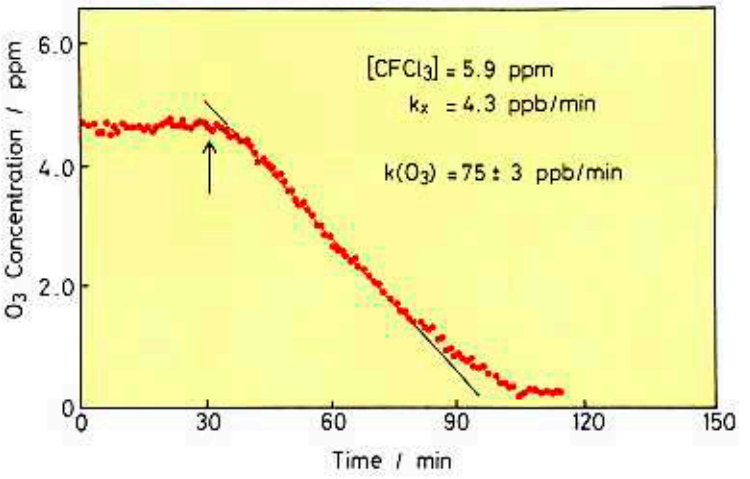


Fig. 2
Simulation experiment for stratospheric ozone depletion by CFC-11 (CCl_3F).

a long path length Fourier transform infrared spectrometer. In the presence of NO_x, the major primary reaction products were methyl vinyl ketone, methacrolein and formaldehyde. Their yields were in quantitative agreement with those from previous measurements. In the absence of NO_x, the major reaction products observed in the infrared spectra were attributed to organic hydroperoxides and the reaction mechanism was found to be quite different from that in the presence of NO_x.

Based on the model experiments, the ultimate yield of CO was 60%, on a carbon number basis, in the presence of NO_x and 23% in the absence of NO_x. The CO yield in the real atmosphere was estimated to be 30% making the global annual CO production from isoprene about 105 Tg C/yr. Together with a previous estimate of the CO production from terpenes, global CO production from natural hydrocarbons was estimated to be 200 ± 60 Tg C/yr.

Measurement of rate constants of free radical reactions with a photoionization mass spectrometer

The photoionization mass spectrometer can be a very selective detector of many free radicals in the gas phase. Vacuum ultraviolet light, rather than an electron beam, is used to ionize the radicals to avoid interference from fragments of heavier, stable molecules. Due to the low concentrations of free radicals usually encountered, lamps emitting intense atomic resonance lines are necessary. With the proper choice of radical, emission line and lamp window material, it is possible to photoionize only the free radical and nothing else. The combination of flash photolysis and photoionization mass spectrometry has been used to study free radical kinetics.

A couple of recent studies demonstrate the power of this approach. The CH_3O_2 radical was generated by pulsed laser photolysis and was detected directly by photoionization mass spectrometry. The radical was photoionized by the Ar resonance lines (11.62 and 11.83 eV) and detected as the parent ion, $CH_3O_2^+$. Reactions of CH_3O_2 and CD_3O_2 with NO were studied by

time-resolved measurements of the radical ion signals. The following rate constants were obtained at 298 ± 5 K: $k_{CH_3O_2+NO} = (11.2 \pm 1.4) \times 10^{-12}$ $cm^3/m/s$ and $k_{CD_3O_2+NO} = (10.9 \pm 1.3) \times 10^{-12}$ $cm^3/m/s$. These values are 50% larger than those previously reported.

Absolute rate constants for HO_2 + NO and NH_2 + NO reactions were measured by photoionization mass spectrometry coupled with laser flash photolysis. HO_2 and NH_2 radicals were photoionized by an Ar resonance lamp and were detected as their parent ions (HO_2^+ and NH_2^+). The rate constants were determined to be $k_{HO_2+NO} = (6.5 \pm 2.0) \times 10^{-12}$ $cm^3/m/s$ and $k_{NH_2+NO} = (1.9 \pm 0.3) \times 10^{-11}$ $cm^3/m/s$. Both of these rates are consistent with those previously reported.

Upper-Atmospheric Environment Section

The Upper-Atmospheric Environment Section uses lidars (laser radars) and laser remote sensing methods to conduct observational studies of the upper atmosphere.

Lidar observation of tropospheric and stratospheric aerosols and ozone

Aerosols in the troposphere and stratosphere have been observed with the NIES Large Nd:YAG Lidar for more than ten years. Aerosols play an important role in radiative heat transfer which is an intrinsic part of the global climate system and is related to climate change. Also, heterogeneous reactions on aerosol surfaces are important in atmospheric chemistry. One of the purposes of the lidar observations is to construct a model of aerosol distribution which can be used as an input for general circulation models. Another objective is to understand changes in the characteristics of stratospheric aerosols and their effects on ozone depletion.

The potential of new lidar techniques such as the Raman scattering method and the high spectral resolution method are also being studied as methods to measure the optical characteristics and distributions of aerosols accurately without assumptions about aerosol parameters.

Measurement of ozone and other atmospheric trace species is another target of recent studies. We are improving the NIES Ozone Lidar measurements of the lower stratosphere where substantial interference in the aerosol layer occurs. Studies on the optimum wavelength pair for the differential absorption method and on the differential Raman scattering method are being conducted.

Retroreflection in Space (RIS)

The largest among recent activities have been the preparations for laser long-path absorption measurement of atmospheric trace species with the Retroreflector in Space (RIS) for the Advanced Earth Observing Satellite (ADEOS) which is scheduled for launch in 1996. The laser long-path

absorption method for measurements between the ground and a satellite is one of the most sensitive remote sensing techniques for measuring atmospheric trace species. The RIS experiment is the first application of this method. For this measurement, a laser beam is transmitted from a ground station, reflected by the satellite retroreflector and received at the ground station. The absorption spectrum of the atmosphere through the round-trip optical path is measured. Vertical profiles or column contents of trace species are derived from the measured spectra.

Studies on the spectroscopic method used in the RIS, the optical design of the RIS and techniques for the ground system have been conducted. The RIS and the ground system were designed and constructed based on these studies. The new, hollow retroreflector design used for the RIS includes a spherical mirror for one of the three mirrors forming the corner cube (Fig. 3). The ground system was constructed with two single-longitudinal-mode pulsed CO_2 lasers. The measurement of vertical profiles of O_3 and CH_4, and column contents of CFC-12, HNO_3, CO, N_2O, etc. will be carried out from a satellite tracking facility at the Communications Research Laboratory (Fig. 4).

Fig. 3
RIS Engineering Model.

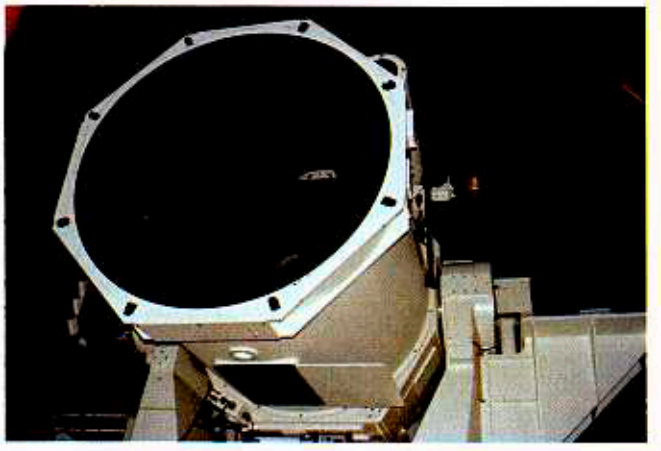


Fig. 4
Satellite tracking telescope for the RIS experiment.

A study of a trace gas monitoring system based on earth-to-satellite laser long-path absorption with a detection system aboard a satellite in geosynchronous orbit is also being conducted for future satellite programs.

Atmospheric Measurement Section

This section's special emphasis has been placed on field studies of atmospheric trace gases including greenhouse gases. The origins, distributions and fates of greenhouse gases, reactive trace gases and aerosols in the troposphere have been studied on a global scale. Greenhouse gas and related species measurements from the Hateruma Island and Point Ochi-ishi ground base stations (sampling temporal variations) and from aircraft (sampling spatial distributions) have contributed to these efforts. We have also studied cloud chemistry in a huge, vertical shaft.

The monitoring of greenhouse gases at the Hateruma Island ground base station

Monitoring Station-Hateruma- is located on the coast of a coral island, Hateruma Island, which is the southernmost island in Japan. Local vegetation and anthropogenic activity there are negligible. The instruments deployed there to monitor the greenhouse gases CO_2 and CH_4 have been developed to operate unattended. Special care is being taken to guarantee state-of-the-art quality of the data. Other items monitored simultaneously, such as ozone, Rn and aerosols, are good indices of air mass origin. Changes in greenhouse gas concentrations over time scales of a few days are attributed to changes of air masses. Such variations correlate positively with Rn and aerosol changes presumably due to the influence of the Asian continent.

Airborne measurements of atmospheric constituents to obtain spatial distributions

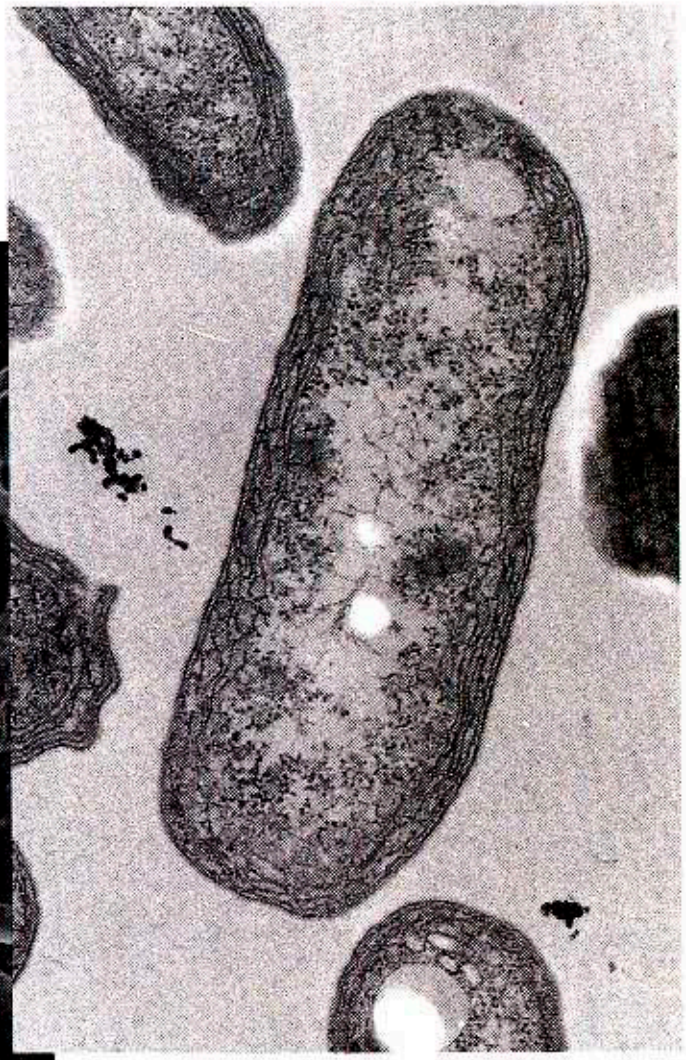
Other than the fact that it is one the largest methane sources, little is known about the methane emission strength of natural wetlands. Methane fluxes measured on the ground vary greatly from place to place, and thus it is important to measure large scale emission rates from natural wetlands. One method to do this is to measure methane from aircraft. A continuous methane measurement system has been developed for this purpose. The principles of this new system are to use a gas chromatograph with a flame ionization detector to measure total hydrocarbons (practically equivalent to methane) and total hydrocarbons minus methane (after methane oxidation in a catalyzer tube) and derive methane concentration by difference. With this new instrument, it was possible to estimate the total amount of methane trapped under the strong temperature inversion over western Siberia during summer 1994.

Cloud chemistry in a huge vertical shaft

Various kinds of processes control the conversion of chemical species in the troposphere. Cloud processes are important for some species and many

investigations by airplane have been carried out to try to understand such processes. However, scientifically useful data are very difficult to obtain from experiments with natural clouds because natural clouds change from hour to hour. An experimental apparatus to form a realistic cloud under controlled conditions is desirable to explore cloud processes in the troposphere. Clouds can form in rising moist air within huge vertical shafts built for ventilation or conveyance in mines. Humidity, and the concentrations of condensation nuclei, aerosols and gas phase chemical components in an updraft in such a shaft can be controlled. We are preparing an abandoned mine shaft at Kamaishi Kouzan in the northern part of the main Japanese island of Honshu for experiments to evaluate the following aspects of cloud chemistry and physics: 1) Size distribution of cloud droplets, 2) Aerosol coexistence within a cloud, 3) Condensation nuclei concentrations and 4) The chemical and physical processes of sulfur dioxide injection into a cloud.

Water and Soil Environment Division



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 as well as biologically available nutrients in aquatic and soil systems. The results of these studies are integrated into biogeochemical models in order to contribute to the conservation and protection of the environmental quality of such systems.

The division consists of four sections, the Water Environment Engineering, Water Quality Science, Soil Science and Geotechnical Engineering Sections. Experimental facilities such as a fresh water microcosm, a marine microcosm, lysimeters, the Environmental Biotechnology Laboratory and the Kasumigaura Water Research Station are currently used in these studies in collaboration with members of the Global Environment and Regional Environment Divisions.

Water Environment Engineering Section

Generation of calcium carbonate by coccolithophores and its role in the oceanic carbon cycle

The carbon cycle associated with photosynthesis and coccolith formation was studied with large scale axenic cultures of the prymnesiophyte *Emiliania huxleyi*. It was found that production of $CaCO_3$ was promoted under phosphate limitation (for the range of cellular C/P ratios greater than 120).

Measurements of ^{13}C stable isotopic ratios for coccolith-free cells and isolated coccoliths, together with associated data for total carbonate and *p*H, indicated that coccolith formation and photosynthesis were linked through their complementary influence on the internal equilibrium of dissolved inorganic carbon.

The relationship between paddy field pesticide runoff processes and their adsorption and degradation

A study was conducted on the mechanism of pesticide runoff from paddy fields into rivers in the catchment area of the Koise River. Both biodegradation and adsorption characteristics of the pesticides were intensively investigated.

The distributions of pesticides between the sediments and overlying water in the paddy fields were almost identical to those predicted by a fugacity model based on the equilibrium approach. The biodegradation of pesticides was found to follow pseudo-first-order reaction kinetics. Based on these results, an integrated model for the fate of pesticides was developed incorporating a tank model for the runoff characteristics, a fugacity model for adsorption and a first-order reaction model for biodegradation.

Humic substances in the aquatic environment

The chemical characteristics of dissolved organic carbon in Lake Kasumigaura were investigated. Non-ionic, cationic and anionic resins were used to separate dissolved organic carbon into six fractions: acidic (equivalent to humic substances), neutral and basic, hydrophobic fractions and acidic, neutral and basic hydrophilic fractions. The acidic fractions were the dominant form of dissolved organic carbon in Lake Kasumigaura. More than 80 % of the dissolved organic carbon existed as organic acids. The hydrophobic acidic fraction accounted for 20 % - 36 % of the dissolved organic carbon and the hydrophilic acidic fraction for 34 % - 64 %. It was suggested that the chemical characteristics of organic acids may reflect those of dissolved organic carbon in Lake Kasumigaura.

Hydrological studies of the global environment with remote sensing data and a geographic information system

Application of remote sensing data is essential to understand changes in temperature, water quality, soil water content, and land use on a global scale. In the current year, a data processing system for global monitoring via satellite remote sensing was installed. Meteorological information such as the earth's surface temperature, atmospheric temperature and short-wave radiation, was analyzed based on the data obtained through a geographic information system (GIS) and remote sensing data acquired by satellites such as those operated by NOAA to evaluate the earth's heat balance. A study was in progress to develop a method to measure evaporation on a global scale with satellite remote sensing data.

Water Quality Science Section

Technology for lake environmental conservation

The potential of a hydroponic biofilter method to purify hyper-eutrophic lake water from Tsuchiura Harbor in Lake Kasumigaura was evaluated. Several kinds of plants were cultured hydroponically in artificial channels, and the rates of removal of particulate and dissolved nutrients from lake water were measured. Chinese Pak-Bung (*Ipomoea aquatica*) showed high rates of removal of organic carbon, nitrogen and phosphorus. The other cultured plants, watercress, water fennel and spearmint, also showed high rates of removal of organic carbon and nitrogen.

Long-term monitoring of water quality and biomass in Lake Kasumigaura

Long-term monitoring of water quality and biomass in Lake Kasumigaura, the second largest lake in Japan, has been carried out since 1976. This lake is typical of eutrophic lakes in Japan and a heavy bloom of blue-green algae had been observed every summer before 1986. Water samples were collected at 10 sites in the lake and the nutrient and chlorophyll a concentrations and biomass and species composition of phytoplankton and zooplankton in these samples were analyzed. Zoobenthos and fishes were also collected from

the lake, and biomass and species composition of these samples also were analyzed. In 1994 precipitation was very low, particularly during the summer season.

Nutrient and chlorophyll a concentrations were relatively low during the summer period. The dominant phytoplankter was an *Oscillatoria* sp. A heavy algal bloom was not observed in the lake in 1994.

Substances which stimulate or inhibit algal growth in lake water

Phosphorus, nitrogen and chelates effectively stimulated the growth of the blue-green alga, *Microcystis*. A fumic acid was fractionated from Lake Kasumigaura sediment as a chelate and its effect on the growth of *Microcystis* spp., isolated from Lake Kasumigaura, was determined. It was demonstrated that 10 mg/l of this fumic acid accelerated the growth of *Microcystis*.

Environmental factors affecting the growth of and musty odor production by *Phormidium tenue* were investigated. Algal growth was stimulated by the addition of phosphorus and nitrogen. A musty odor compound produced by *P. tenue* was identified as 2-methylisoborneol (2-MIB) by GC analysis. The maximum musty odor production, 190 µg/l of 2-MIB, was obtained at 0.1 mg-P/l.

The fate of environmental pollutants in aquatic environments

Groundwater and soil contamination by volatile chlorinated aliphatic compounds such as tetrachloroethylene (PCE), trichloroethylene (TCE), and 1,1,1-trichloroethane have been detected in many places in Japan. We have developed a bioremediation technology to clean up contaminated soil and groundwater with microorganisms. A TCE degrading bacterium was isolated by the enrichment culture method. The isolate, strain M, was identified as a *Methylocystis* sp. and was able to degrade TCE at concentrations up to 35 ppm.

We studied the TCE degradation characteristics of strain M which is able to degrade various chlorinated compounds. We determined the various metabolites of TCE with a tracer experiment. 32% of TCE was converted to CO and CO_2, 32% entered the water soluble fraction and 36% was in the cells. TCE is oxidized to TCE oxide by methane monooxygenase and TCE oxide spontaneously reacts to yield carbon monooxide, formic acid, glyoxylic acid and dichloroacetic acid. Another pathway is present. Chloral, produced by the chloroshift reaction, is converted to trichloroacetic acid and 2,2,2-trichloroethanol. We constructed bioreactors of immobilized cells to reduce liquid and gaseous TCE concentrations.

Alginate immobilized cells showed high degradation activity. Alginate immobilized strain M was effective at continuously degrading liquid and

gaseous TCE. TCE degradation in soil was also studied using strain M. More than 90 % of an initial 1 ppm TCE in soil was degraded within one day after the addition of strain M. Strain M was effective at removing TCE from contaminated soil and groundwater.

Soil Science Section

The behavior of inorganic pollutants in soil

Soil cores (ca. 30 cm long) were collected from undisturbed sites around old parks and castles in the principal cities as well as at remote mountainous sites. The soil samples were analyzed by several multi-element analytical techniques including non-destructive (neutron activation and X-ray fluorescence analyses). Significant heavy metal contamination of surface soils, which increased with relative population density, was observed. For example, concentrations of Pb and Zn in Tokyo reached more than 200 and 500 ppm, respectively. Potential contamination was also observed in the mountainous areas.

The behavior of microorganisms in soil

The survival in soil of an inoculum of γ-HCH-assimilating *Sphingomonas paucimobilis* (short rod, 0.7 by 1.3 μm) was investigated by inoculating cells into micro-capillary pores (pores with necks between 0.19 and 3 μm) and macro-capillary pores (pores with necks between 3 and 48 μm) of six soils that had been presterilized by autoclaving. The inoculated soil samples were incubated at final soil moisture contents corresponding to a matric potential (also known as field capacity) of -6.2 kPa at 25°C in the dark. Viable cells were quantified using the Most Probable Number (MPN) dilution method. This study is continuing, and data are still coming in.

The behavior of heavy metals in soil and their effects on microorganisms and a plant

The forms of zinc (Zn) added to five kinds of soils and their effects on the activities of soil microorganisms and the growth of wheat were investigated. The activities and growth, which decreased with the addition of higher amounts of Zn, varied with soil type. When the soil Zn concentration was based on the water-soluble form, the critical level for effects on activity and growth appeared to be identical for all soils, 1-10 mg/kg. These results suggest that the speciation of Zn in soils, especially the water-soluble forms, affect Zn's impact on microbial activity and wheat growth .

The behavior of natural radionuclides in rainfall and the atmosphere

Atmospheric concentrations of ^{210}Pb and their variations over Urumqi, Lanzhou and Baotou cities, located in inland areas of China, were measured for one year in 1992. The monthly average concentrations ranged from 0.3 to 4.6 m Bq/m^3. The concentrations over these cities in winter were several times higher than that observed in Tsukuba, and the range of variation was also larger. The variations in concentration over the three localities were

similar, showing the same seasonal pattern of variation: low concentrations occurred in summer and high concentrations in winter. This pattern of variation was different from that observed in Tsukuba, where a "two-peak" pattern with high concentrations occurring in spring and fall was observed. The variations in concentration over the Chinese continent, where precipitation is much lower than that in Japan, correlated quite well with the variations in precipitation.

Statistical analysis of soil distribution patterns using a geographic information system (GIS)

A geographic information system to analyze the soil distribution pattern in Japan is being developed. We have compiled the "Digital National Land Information" Database including edaphic conditions such as relief, landform, surface geology, etc. and the "Grid Climatic Value" Database including climatic conditions such as monthly temperature, monthly precipitation and snowfall depth. Both databases are arranged in accordance with the "National Grid Code System" with approximately 1 km × 1 km grid cells. Moreover we have digitized the data from thousands of vegetation investigation sheets which were collected by "the Basic Survey on Natural Environment Conservation" conducted by the Environment Agency of Japan. The soil distribution and environmental conditions affecting it are now being analyzed with these databases.

Long-term changes in oceanic element cycles

A gravity sediment core (GC1002, 398 cm long), collected from the Kerguelen Plateau off Enderby Land, Antarctica (63°48'30"S, 78°53'27"E; 3658 m depth), was analyzed for biogenic silica (opal) and calcium carbonate. The opal contents were approximately constant within the range of 2 ± 1.5 % in the sediment layers deeper than 110 cm, but increased up to 9 % in the shallower layers with a minimum content of 5 % at 10-20 cm depth. This opal distribution suggests that primary production has increased since ca. 320 ky ago and may have decreased during the last glacial period. The proportions of opal and calcium carbonate in sediments may be useful indicators of the long-term variations in marine environments, including changes in primary production.

Geotechnical Engineering Section

The Saga Plain, which is situated in the southern part of Saga Prefecture, has a coastline along the northern shore of the Ariake Sea. This coastline is a typical area of land subsidence where significant subsidence has occurred continuously and adequate countermeasures are urgently needed.

The Saga Plain is composed mainly of deltaic plains and is known for its large reclaimed areas. Drainage from the extensive rice paddies occurs in the topset of the delta along the coast of the Ariake Sea. Thus irrigation in these areas must depend mainly on the groundwater supply.

Figure 1 shows typical geological profiles of this plain. The top layers consist of very soft cohesive layers named the Ariake Clay Formation and is composed mainly of marine clay and silt Holocene deposits.

The next layer is the Shimabara Bay Formation, deposited during the latest Pleistocene, composed mainly of fluvial sediments. The next layer is the late Pleistocene Group. This group contains a lot of intercalated pumice-bearing volcanic ash. This volcanic ash came mainly from Mt. Aso, namely Aso-4 bed and Aso-3 bed which arose about 70 and 110 ka, respectively. The middle and early Pleistocene Groups are composed of sand and silt with gravel. At Ariake, the middle Pleistocene Group is composed mainly of gravel, which came from Mt. Tara, as mud and/or debris flows. High quality groundwater had been pumped excessively from many wells in these sand and gravel beds from depths of about 50 to 200 meters.

The groundwater level decreased remarkably during summer due to excessive groundwater pumping primarily for agricultural purposes. As a consequence, rapid subsidence of the ground occurred. It was also observed that though the groundwater level ascended from winter to spring, the ground scarcely rebounded. Consequently, the subsidence accumulated to a large extent. The Fukutomi Town Office Building, which was built in 1967, was constructed on piles supported on the upper sand bed of the middle Pleistocene Group. In 1994, seven risers had to be added to the front steps of this building as the ground had subsided about 2 meters.

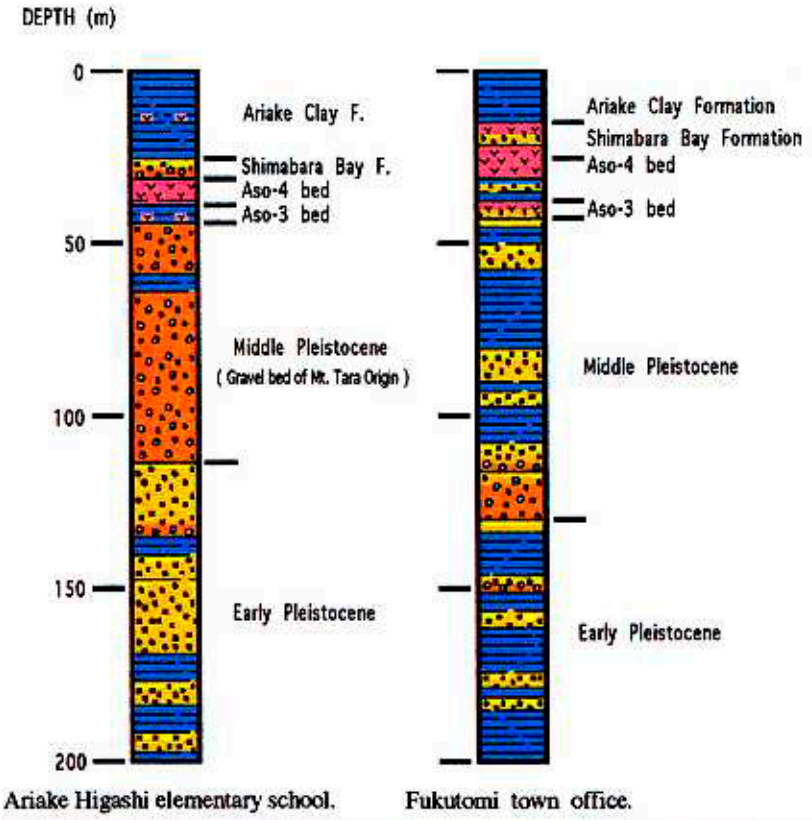
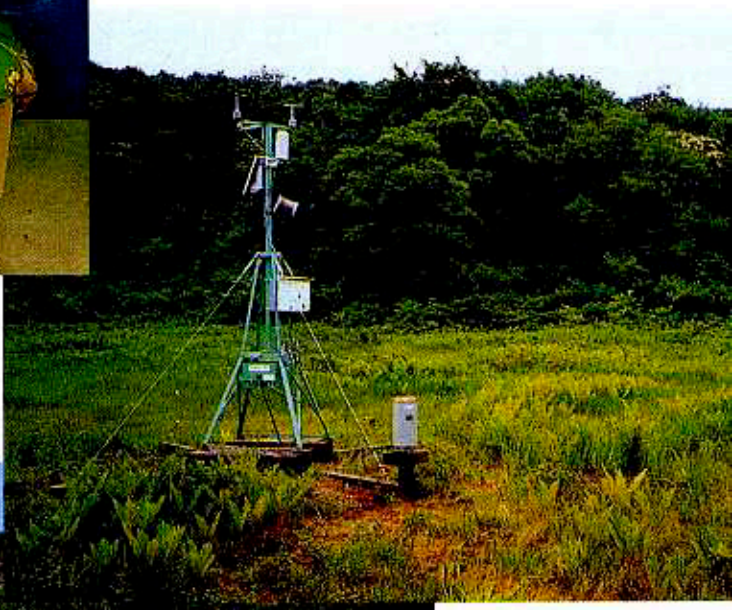


Fig. 1
Geological columnar sections from the Ariake Higashi elementary school site and the Fukutomi town office site in Shiraishi district.

The normal consolidation tests were performed on samples taken from the underground clay layers at Fukutomi. The overconsolidation ratios were 1.0 - 1.4 from 5 to 110 meters depth and about 2.0 from 150 - 195 meters depth.

Environmental Biology Division



The Environmental Biology Division consists of four sections: the Molecular Biology, Environmental Microbiology, Environmental Plant Science and Ecosystem Study Sections. The division performs 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 genes, species and ecosystem. In 1994 we performed 12 studies funded by NIES and three studies funded by the Science and Technology Agency. In addition, a special research project for the conservation of mire ecosystems has been conducted by the Environmental Biology Division. The results of this project are included in the Regional Environmental Research Division chapter. Selected research results from the respective sections of the Environmental Biology Division will be described in the remainder of this chapter.

Studies in the **Molecular Biology Section** were performed on 1) the cloning and structural analysis of genes encoding active oxygen-scavenging enzymes, 2) the effects of environmental factors on the expression of such genes and 3) the sensitivities of transgenic plants with various active oxygen-scavenging enzyme activities to environmental stresses.

The effects of ozone and sulfur dioxide on antioxidative enzymes were investigated in higher plants. Both ozone and sulfur dioxide increased the activities of ascorbate peroxidase (APX) and guaiacol peroxidase in leaves, but had little effect on the activities of superoxide dismutase (SOD), catalase, monodehydroascorbate reductase, dehydorascorbate reductase and glutathione reductase (GR). The activities of both peroxidases were induced more effectively by ozone than by sulfur dioxide. APX activity during 0.1 ppm ozone fumigation increased 1.8-fold without a lag period. In contrast, guaiacol peroxidase activity under the same conditions increased 4.4-fold with a 1-day lag. Expression of the gene encoding the cytosolic APX was further investigated. Leaf protein levels four and eight days after exposure to 0.1 ppm ozone were 1.5-fold higher than those in controls. Both ozone or sulfur dioxide had induced elevated APX mRNA levels by days 4 and 7, whereas by day 1, only ozone had been effective. The induction of higher APX mRNA levels by ozone (3.4 to 4.1-fold increase) was more prominent than that by sulfur dioxide (1.6 to 2.6-fold increase). APX mRNA increased during the day and decreased at night. Exposure of plants to 0.1 ppm ozone enhanced the APX mRNA level within 3 h. These fumigated plants showed diurnal changes similar to those in the control. These results demonstrate that near-ambient concentrations of ozone as well as similar concentrations of sulfur dioxide can induce APX gene expression (Fig. 1).

A DNA fragment that consisted of the promoter of the tomato ribulosebisphosphate carboxylase small subunit 3B gene and the reverse-

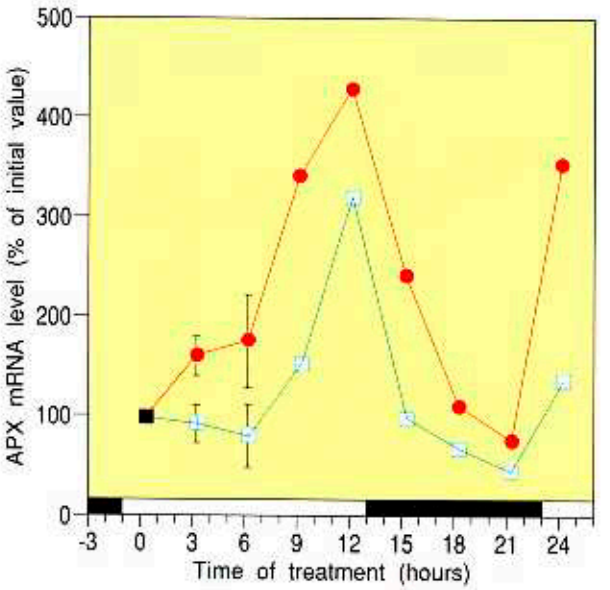


Fig. 1
Effects of ozone on the ascorbate peroxidase (APX) mRNA level. Plants were exposed to 0.1 ppm ozone □or clean air● in fumigation chambers under a 14:10 light-dark cycle (light 5:00 - 19:00). Ozone exposure started at 6:00 (0 hour). Open and solid bars represent light and dark periods, respectively. Mean values of two or three independent experiments are shown. Vertical bars represent SD (n=3).

directed cDNA of spinach chloroplastic GR was introduced into tobacco cells. The resulting transgenic tobacco (*Nicotiana tabacum* L. cv SR1) with decreased GR activity exhibited enhanced sensitivity to paraquat, an active oxygen-producing herbicide, in the light as evaluated by chlorophyll destruction and electrolyte leakage from leaf discs. This result demonstrates the involvement of GR in the tolerance of plants to herbicide induced photooxidative stress.

In the **Environmental Microbiology Section**, studies have been carried out on 1) the diversity of microorganisms, 2) the distribution and culture of charophytes which are in urgent need of protection and 3) the enzymology of soil organic matter decomposition.

A cladistic analysis was used to deduce the phylogenetic relationships within an algal group. Forty-one pairs of characters related to gross morphology and ultrastructure of vegetative colonies as well as asexual and sexual reproduction were analyzed based on parsimony, using the PAUP 3.0 computer program, for 25 species belonging to the colonial Volvocales (Chlorophyta). The resulting strict consensus tree indicated the presence of two monophyletic groups. These two groups constituted a large monophyletic group, to which *Gonium sociale* was a sister group (Fig. 2). The colonial Volvocales were segregated into three families: the Tetrabaenaceae, the Volvocaceae and the Goniaceae. The phylogeny of the unicellular marine volvocalean flagellate *Chlamydomonas parkeae* (Chlorophyta), which has a peculiar pigment composition similar to that of the prasinophycean algae, was studied on the basis of DNA sequence data. The phylogenetic tree inferred from the sequence data indicate that *C. parkeae* is solidly placed within the typical volvocalean lineage. It is considered, therefore, that the pigment composition data for *C. parkeae* does not reflect the phylogenetic position of this species.

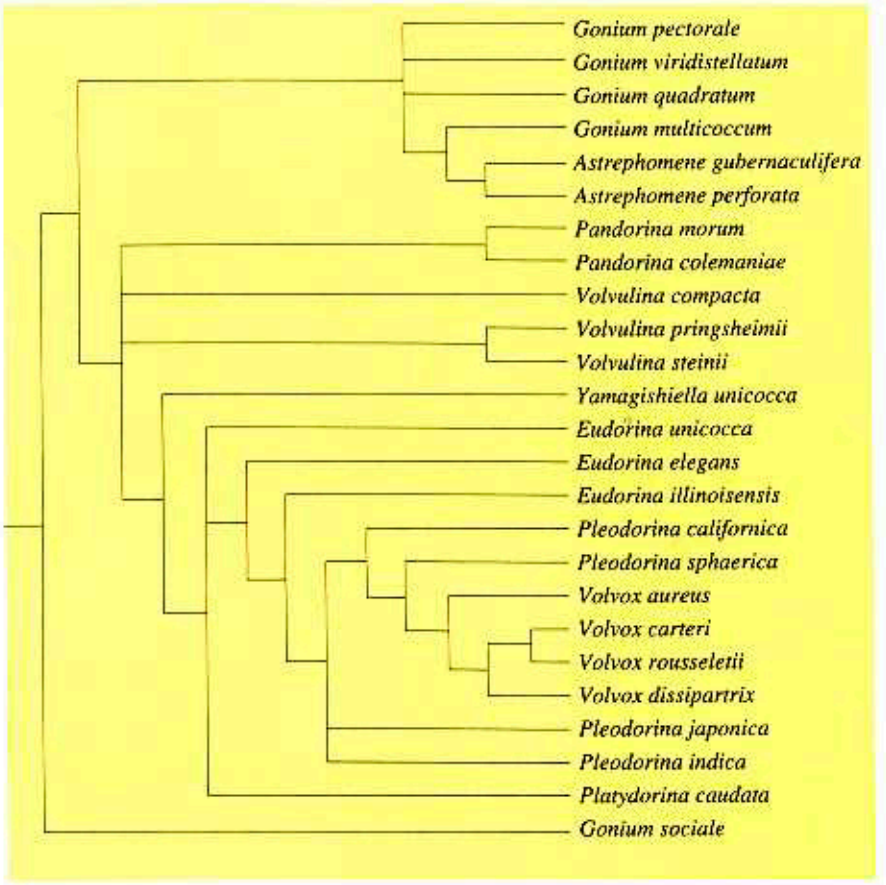


Fig. 2
A phylogenetic tree of the colonial Volvocales constructed using morphological characters.

The distributions of charophytes in 14 Japanese lakes were surveyed and compared with those surveyed before 1963. Although 22 kinds of charophytes lived in these lakes before 1963, only four species still survived. All charophytes were extinguished from nine of these lakes. The extinctions of charophytes from these lakes was caused by recent eutrophication, the introduction of grass carp (*Ctenopharyngodon idellus*) or fluctuations in water levels of lakes managed for hydroelectric power generation. *Chara globularis* var. *hakonensis* and *Nitella minispora* became globally extinct and *Nitellopsis obtusa* and *Tolypella gracilis* disappeared from Japan. In addition, four other species, *Nitella flexilis* var. *bifurcata*, *N. furcata* var. *fallosa*, *N. gracilens* and *N. hyalina* face extremely high risks of extinction from the wild in the near future (Table 1).

The **Environmental Plant Science Section** studied 1) the effects of air pollution, global warming and desertification on plants and vegetation and 2) the development of new instrumentation techniques for diagnosing these effects.

The ecophysiological characteristics of plants growing in arid and semi-arid regions of China were investigated in collaboration with researchers from the Xinjiang Institute of Biology, Pedology and Desert Research, the Lanzhou Institute of Desert Research and the Institute of Botany, Chinese

Table 1
Change in the charophyte flora in 14 Japanese lakes during the past 30 years.

Lakes	Before 1963										1993-1994		
L. Onuma	*1	5	10								none		
L. Kasumigaura	1	3	5	10							none		
L. Chuzenji	1	5	10	11							1	5	10
L. Yunoko	5	12									5	12	
L. Inba	1	3	4	5	8	9	16				none		
L. Tega	1	3	5	9	12	14	16	18	19	22	none		
L. Yamanaka	1	5	10	16	21						1	5	10
L. Ashinoko	1	2	5	6	10	15	16	20	21		1	5	10
L. Kawaguchi	1	5	10	15	21						1	5	10
L. Suwa	1	10									none		
L. Kizaki	1	10	17								none		
L. Nakatsuna	1										none		
L. Nojiri	1	4	7	10	13	15	18	21			none		
L. Aoki	not surveyed										none		

* 1. *Chara braunii*, 2. *C. batrachosperma*, 3. *C. corallina*, 4. *C. fibrosa* subs. *benthamii*, 5. *C. globularis* var. *globularis*, 6. *C. globularis* var. *hakonensis*,7.*C. sejuncta*, 8. *C. zeylanica*, 9. *Nitella acuminata* var. *capitulifera*, 10. *N. flexilis* var. *flexilis*, 11. *N. flexilis* var. *bifurcata*, 12. *N. flexilis* var. *longifolla*, 13. *N. furcata* var. *furcata*, 14. *N. furcata* var. *fallosa*, 15. *N. gracilens*, 16. *N. hyalina*, 17. *N. minispora*, 18. *N. morangii* var. *oligogyra*, 19.*N. orientalis*, 20. *N. pseudoflabellata* var. *pseudoflabellata* f. *macrophila*, 21. *Nitellopsis obtusa*, 22. *Tolypella gracilis*

Academy of Sciences. Seeds from over 30 species were collected in arid and semi-arid regions of Xinjiang, Gansu, Ningxia and Inner-Mongolia and propagated in NIES's phytotron, where they all grew to maturity. Each of these species exhibited different degrees of resistance to water and salt stresses. For example, *Agriophyllum squarrosum*, a pioneer species growing in shifting dunes, has proven to be more sensitive to water stress than other species growing in fixed and semi-fixed dunes. *Halostachys caspica*, a halophyte growing in Xinjiang, showed optimal growth when the NaCl concentration of the culture water was 250 mM (Fig. 3).

Imaging instrumentation techniques, which collect two- or three-dimensional information about the ecophysiological functions of plants in non-destructive ways have been examined. A portable thermographic

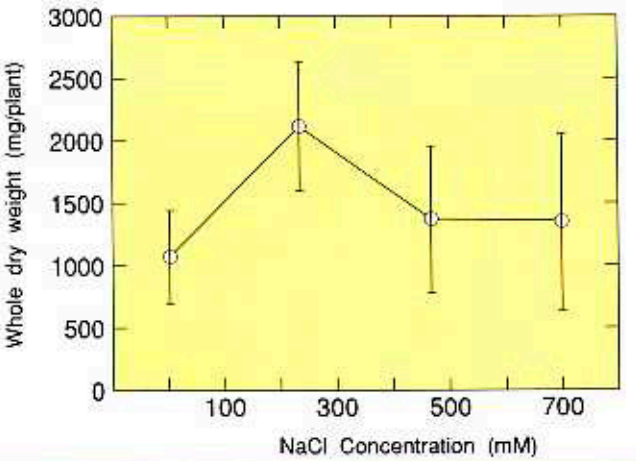


Fig. 3
Effect of salt stress on the dry weight growth of *Halostachys caspica*.

system was used to evaluate the spatial variability of stomatal response to ozone exposure in attached leaves of some trees. The local leaf temperature increased heterogeneously with ozone exposure time under a controlled thermal environment because of stomatal closure and the death of the leaves. Although it was difficult to measure spatial differences in the response of stomata of trees with attached needle leaves using ordinary porometers, the portable thermographic system made it possible to obtain such spatial information easily. This system was also used to evaluate zelkova trees growing along an urban street and other species growing in urban temple woods both from the ground and from a helicopter. It was possible to reliably diagnose slight damage to trees not observable in photographs from the thermal images obtained under even cloudy skies with any irradiance above ca. 300 mol photon/m^2/s. Remote sensing measurements from a helicopter had to be made from an altitude below 300 to 500 m in order to obtain the exact temperatures of individual trees. A stereoscopic TV system with a computer-controlled light microscope system has been developed as another imaging technique to observe cells, tissues and stomata. In addition, fluorescence image analysis systems with functions of pulse amplitude modulation and laser scanning have been investigated as tools to diagnose photosynthetic activity.

Research was performed in the **Ecosystem Study Section** on: 1) the microbial loop in lakes, 2) the effects of nutrient concentrations and supply ratios on phytoplankton composition, 3) the effects of environmental stress on aquatic plants in transition zones of lakes and wetlands, 4) the ecological properties of brackish zoobenthos, 5) the food web structure and trophic relationships in stream benthic communities and 6) fireflies as bioindicators of environmental states.

Picophytoplankton abundance and biomass were investigated in relation to nutrient concentrations and total nitrogen (TN): total phosphorus (TP) ratios of the epilimnetic waters of 31 Japanese lakes during the warm season in 1994. Picophytoplankton biomass, as chlorophyll a, was generally less than 7 μg/l. Exceptionally high values (17-29 μg/l) were observed in hypertrophic lakes such as Lake Abashiri and Koyama Pond. The picophytoplankton contribution to total chlorophyll a tended to be higher in oligotrophic and mesotrophic lakes and lower in hypertrophic lakes. However, 80% of the chlorophyll observed in hypertrophic Lake Abashiri was contributed by picophytoplankton. Picophytoplankton abundance was not related to TP concentrations. High densities of picocyanobacteria were observed in lake waters with TN:TP ratios between 10 and 80 (Fig. 4).

Semi-continuous bottle incubation experiments were conducted twice, in the spring and summer, to investigate the relationship between phytoplankton dominance and the supply ratio of nitrogen (N): phosphorus (P). The

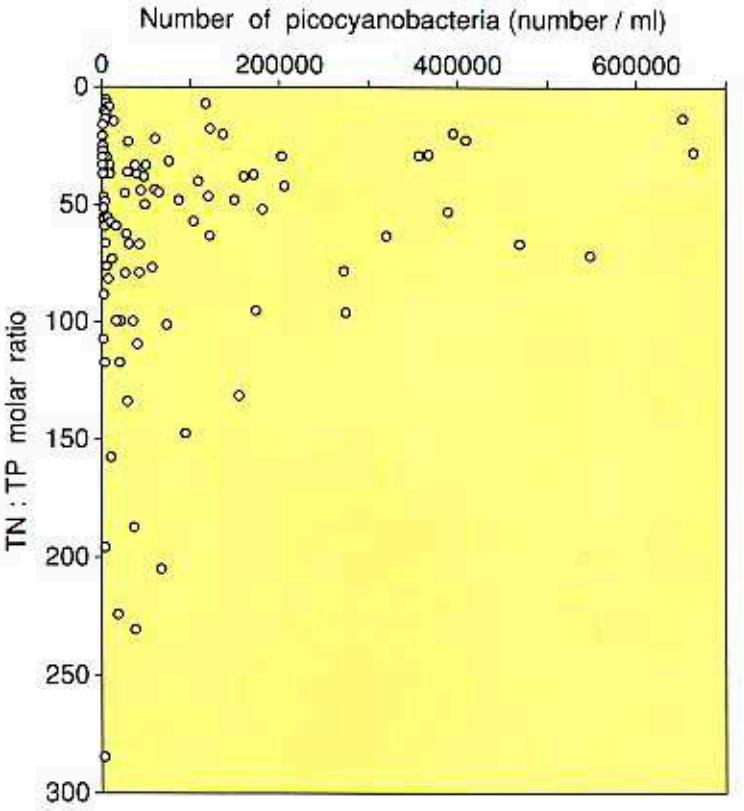


Fig. 4
Picocyanobacteria abundances in relation to the total nitrogen (TN): total phosphorus (TP) ratios in 31 Japanese lakes. Observations were made three times (spring, summer, autumn) for each lake.

dominant species after one month of incubation clearly changed depending on the supply ratio of N:P. In bottles in which the N:P supply ratios were 10, 30, 50 and 100 (by moles), the dominant species became *Chlorella* sp., *Eudorina elegans*, *Scenedesmus setigera* and *Gonium sociale*, respectively, during the spring experiment. During the summer experiment, the dominant species became *Schroederia setigera*, *Synedra acus*, *Oscillatoria guttalata*, and *O. quasiperforata*, respectively. Thus, the N:P ratio in lake water is an important factor regulating algal dominance.

The role of buried-in-soil seeds in succession was studied in artificial wetlands on the eastern shore of the Chesapeake Bay, U.S.A. Seed number and the diversity of aquatic plants were higher near the shoreline than in open water areas. The topography, vegetation, soil moisture and plant size were surveyed in a 5-year old wetland. *Hibiscus moscheutos* seedlings had a narrower distribution than did the adult plants. The germination rate of *H. moscheutos* seeds was maximal in the zone near the shoreline where the soil matric potential was 14-17 cm kPa. Soil moisture of the wetland was one of the most important environmental stresses regulating the distribution and growth of aquatic plants.

Environmental Information Center

Welcome to

NIES

National Institute for Environmental Studies

NIES World Wide Web Server (WWW) (Experimental)

Japanese Pages

WHAT'S NEWS

NIES Information

About NIES

Activity & Research at NIES

Global Environment Research

Environment Information Center

Center for Global Environmental Research

Other Internet Resources

Environmental Related Servers

The Environmental Information Center is responsible for the collecting, processing and provision of domestic and foreign environmental information, as well as supporting research through the control and operation of computers and related systems.

Information Management Section

INFOTERRA

INFOTERRA, the Global Environmental Information Exchange Network has been designed by the United Nations Environment Programme (UNEP) to stimulate and support the exchange of environmental information between partners. The system is operated at the national level by national focal points. As of March 1995, 170 countries participated in INFOTERRA and information sources registered in INFOTERRA numbered about 6,800.

The center is designated as the INFOTERRA National Focal Point of Japan and is responsible for maintaining a database on the sources of information in Japan, providing it to the INFOTERRA Programme Activity Centre and responding to requests for information. At present, 511 information sources are registered in Japan accounting for 8% of all INFOTERRA registered sources.

EI-NET

Many municipal and prefectural research organizations are studying the environment and playing an important role in environmental protection. A close cooperative relationship between these organizations and NIES is particularly important. To enhance information exchange among these organizations and NIES, the center established a communication system called the "Environmental Information Network" (EI-NET) in March 1991, with a personal computer serving as the host. About 170 users have subscribed to EI-NET. This system has functions such as Special Interest Groups (SIG) for discussing specific subjects, Closed User Groups (CUG) for information exchange in specific user groups, joint report writing, electronic mail, a bulletin board system, etc. These functions are available to the registered users via the Value-Added Network (VAN); Tri-p for individuals or through the laboratory's internal on-line system.

Management and operation of computer and related systems

The center handles the management and operation of the general-purpose computer systems, the supercomputer system and the NIES local area network (LAN).

The general-purpose computer system has a HITAC M-680/180E central processing unit. This system is used for calculation of environmental simulations, analysis of data measured in test facilities, analysis of remote sensing data along with associated image/figure processing, operational processing of various databases, etc.

Our NEC SX-3 Model 14 supercomputer system employs the SUPER-UX (UNIX-based) operating system and is equipped with a FORTRAN compiler (with high-level debugging, high-efficiency optimization, high-level vectorization and various supportive tools for efficiently compiling and executing large-scale programs to handle global environmental problems. It is also equipped with a real-time image processor and a 3-dimensional graphics processor. These features are necessary because understanding earth system processes, evaluating their effects and making projections into the future are all facilitated by visualizing the results of global environmental research calculations.

A LAN called the NIES Network (NIESNET) has been established at our institute. Each institute researcher can access the supercomputer system or the general-purpose computer system from their own desk through the LAN. Foreign as well as other Japanese registered users can remotely access the supercomputer system through NIESNET's connection to the internet via the Inter-Ministry Network (IMnet).

Database Section

Processing and provision of data files of numerical environmental data

A wide range of numerical, environmental data is assumed to be necessary for both environmental research and environmental policy development, implementation and enforcement. The center has compiled, processed, stored and provided access (in computer-accessible form) to data files of air and water quality monitoring data.

Ambient air quality monitoring data files consist of: 1) the Hourly Ambient Air Quality Data file (FY 1976 - present); 2) the Monthly and Yearly Ambient Air Quality Data file (FY 1970 - present); and 3) the Ambient Air Monitoring Station Attribute Data file (FY 1977 - present).

The Hourly Ambient Quality Data file has been compiled by editing monitoring data from local governments. The Monthly and Yearly Ambient Air Quality Data file has been compiled by editing data files from air pollution monitoring stations and automobile exhaust gas monitoring stations which are transmitted by local governments to the Environment Agency under the Air Pollution Control Law.

Water quality monitoring data files consist of: 1) the Water Quality Monitoring Data file (FY 1971 - present); 2) the Yearly Water Quality Monitoring Data file (FY 1983 - present); and 3) the Water Quality Monitoring Site Attribute Data file (FY 1975 - present). These files include the data from water quality monitoring of public waters, which are transmitted by local governments to the Environment Agency under the Water Pollution Control Law.

These data files are provided to outside users including other governmental organizations and laboratories. Also a duplication service for use by the general public is available for some files. Exchange of data files with other governmental organizations also occurs.

Collection and processing of information

The General Reference System for the Natural Environment has been developed since FY 1991 to provide basic reference materials which facilitate understanding of the present condition and forecasting changes in the natural environment. In the Phase 1 program, a database system (GREEN) was developed, using a general-purpose computer system, to enable searches for and display of natural environmental data from all over Japan. In FY 1994, the Phase 2 program for the development of the General Reference System for the Natural Environment for personal computers (P-GREEN) began based on previously recorded results and data.

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 available to the general public. The compilation includes information about where and in what mode environmental information is being accumulated (environmental information sources). In FY 1994 the Environmental Information Providing System Development Survey began to update our information about the approaches used by environmental information sources. Explanations of laws, treaties and terms concerning the environment were compiled on floppy disks and distributed to the general public through a public corporation.

Library and Research Information Section

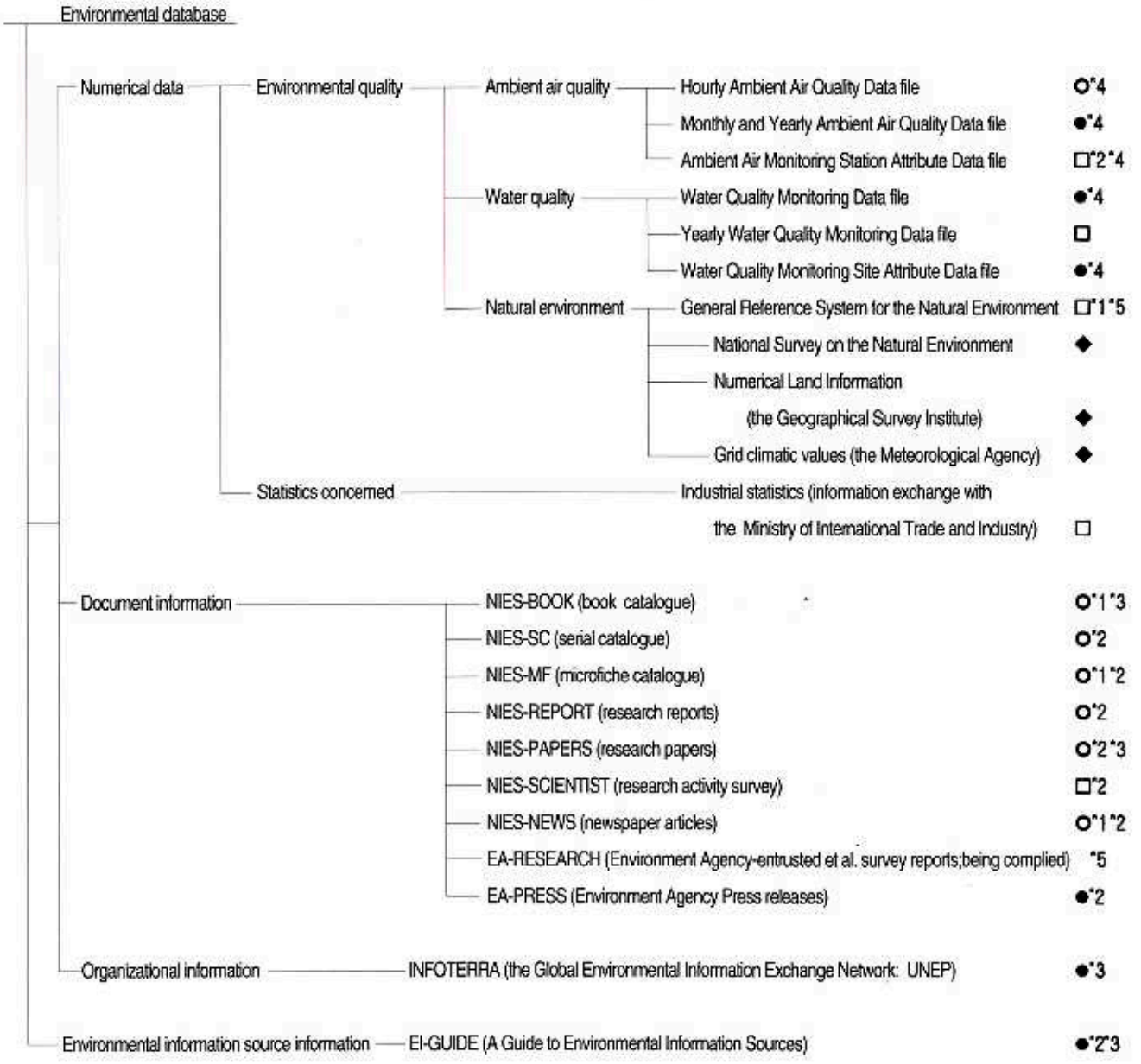
Compilation of documentary information concerning environmental research

Documentary information concerning the environment is essential to the execution of environmental research and environmental administration. Database systems containing information documents about the environment have been created to meet such needs. In addition, access to other Japanese and foreign commercial databases has been provided to institute users.

Several local institute database systems, NIES-BOOK (book catalogue), NIES-SC (serial catalogue), NIES-MF (microfiche catalogue), NIES-REPORT (research reports), NIES-PAPERS (research papers) and NIES-SCIENTIST (research activity survey) have been compiled and installed.

Other databases available off-line in the institute include NTIS, MEDLINE, EI Energy and Environment, Environmental Library and Current Contents on Diskette (CCOD) on CD-ROMs or floppy disks.

Access to several other on-line databases, JOIS, DIALOG, STN-International, G-Search and ASSIST, is also provided.



Availability Codes

- ● Provided to general public
- ○ Provided to administrative organizations, researchers, etc.
- □ Restricted to use in NIES/EA
- ◆ Restricted to use in available system
- *1 Available on the general-purpose computer system
- *2 Available on personal computer systems
- *3 Available on NIESNET
- *4 Restricted availability on NIESNET
- *5 Partly available in NIES/EA

Fig. 1
Composition of NIES Environmental Databases

Library management and operations

As of March 1995, about 34, 000 books, 650 technical and scientific serials, 8,500 maps, 98,500 microfiches and various other reports and reference materials were in the NIES library.

Library facilities include separate reading rooms for books, for journals, for indexes and abstracts, for reports and for maps and microfiche as well as a database access room and a photocopying room.

Editing/publication

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

In FY 1994, NIES published the Annual Report, the Annual Report on Special Research, the Annual Report of Global Environmental Research, one Report of Special Research from NIES, one Research Report from NIES, 17 Reference Reports, 10 Center for Global Environmental Research Reports and the NIES news (6 times/year).

These publications were distributed through a document exchange system to appropriate organizations concerned with environmental issues such as the National Diet Library, national/international environmental research organizations and many national, prefectural and local government offices and departments.

Center for Global Environmental Research

The industrial activity facilitated by modern science has provided an unprecedented level of prosperity for many of the world's people. Unfortunately, this same industrial activity has produced drastic changes in the global environment. It is becoming clear that both domestic and international countermeasures are necessary to slow the degradation of our environment. However, international consensus for decisive countermeasures is hampered by the lack of scientific understanding of global environmental change. It is therefore necessary to further the scientific understanding of human impacts on the global environment and to provide a basis for implementing preservation measures.

In view of this situation, the Center for Global Environmental Research (CGER), an organ of the National Institute for Environmental Studies of the Environment Agency of Japan, was established in October 1990 to contribute broadly to the scientific understanding of global change and the elucidation of and solutions for our pressing environmental problems. The center will achieve these goals through facilitating the integration of global environmental research from interdisciplinary, multi-agency and international perspectives, providing research-support facilities such as databases and a supercomputer, and offering its own data from long-term monitoring of the global environment.

CGER has three major activities: integration of global environmental research, management of global environmental database and global environmental monitoring.

Research Integration

The objectives of the Research Integration are: 1) to ensure communication and networking among researchers and decision makers; 2) to cooperate with the Research & Information Office of the Global Environment Division 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 research; 4) to manage research programs utilizing 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 1994. Some, such as the annual Global Environment-Tsukuba, brought together researchers and decision makers with the general aim of furthering communications. Others, such as the 1995 Tsukuba Global Carbon Cycle Workshop (Fig. 1), the Workshop on Land Use for Global Environmental Conservation (LU/GEC) 1994 and the Third Japan - U.S. Workshop on Global Change with the subtitle Modeling

Fig. 1
Tsukuba Global Carbon Cycle Workshop.

and Assessment —Improving Methodologies and Strategies—, sought to discuss future research priorities and the possibility of international research collaboration on various specific issues.

CGER also supported the efforts of groups seeking to organize workshops or symposia on specific research programs. Such groups include the Siberian Field Research Project and the Tropical Rain Forest Research Project. In addition, CGER cooperated with International Geosphere-Biosphere Programme (IGBP) - Japan in convening its Land Use/Cover Change (LUCC) - Japan Workshop on June 19-20, 1994 in Kyoto.

Cooperation to promote and coordinate global change research

CGER has advised the Research & Information Office, from a scientific point of view, on its effective promotion of the Global Environment Research Program.

An international research network, involving scientists in both developed and developing countries, is indispensable to further scientific understanding of global change. The Asia-Pacific Network for Global Change Research (APN) has been set up via an inter-governmental framework and efforts to establish three subregional networks in this region under the SysTem for Analysis, Research and Training (START) have been launched via a non-governmental scientific framework. CGER has been working to have these two approaches complement each other.

CGER is actively participating in the work of the Intergovernmental Panel on Climate Change (IPCC) which typifies international efforts to promote communication between the scientific community and decision makers, especially as it relates to impact assessment and policy options (IPCC Working Groups II and III, respectively). CGER co-chaired (with the University of Oxford) a guidelines team which issued "Preliminary Guidelines for Assessing Impacts of Climate Change (1992) IPCC/UNEP/

WMO" and "IPCC Technical Guideline for Assessing Climate Change Impacts and Adaptations (1994) IPCC/UNEP/WMO" as part of the IPCC 1994 Report. CGER also made a significant contribution to the preparation of the 1995 reports entrusted to Working group III. In addition, since 1993 CGER has offered scientific consultation to the Eco-Asia Project which proposes methods of sustainable regional development to Asian and Pacific countries.

Coordinating supercomputer-aided research programs

In March 1992, CGER installed a supercomputer system (NEC SX-3, model 14) to facilitate research on global change. CGER has convened an annual workshop on supercomputer-aided research programs and published an annual activity report to disseminate the advanced knowledge obtained by the users of the supercomputer.

Integrated research on policy options

Integrated research, a special research category in the Environment Agency's Global Environment Research Program, aims to direct research efforts towards actual decision making processes through the development of conceptual models and the generation of data commonly used in interdisciplinary research. The following three research projects in this category have been carried out.

1) Development of global models for sustainable development.

For the precautionary approach, modeling is an essential tool to evaluate policy options in advance of implementation. A general Equilibrium Model which evaluates the optimal carbon tax for stabilization of CO_2 emissions and a Global Environmental Framework Model to analyze the relationships between development and environment at national as well as regional scales are being developed.

2) Urban design and life style change for reductions in the global environmental load.

An international comparative social survey has revealed differences among citizens in the U.S., Europe and Japan in their attitudes toward nature, science and policy. Urban structures and management systems that increase the wasteful use of energy were pointed out and environment-oriented design policies were proposed.

3) Establishment of environmental and natural resources accounting systems.

To evaluate national resources from an environmental, as well as an economic point of view, it is essential to assess the deterioration of the environment. United Nations Statistics Office (UNSO) is now developing a common national resources accounting system as a satellite accounting to System of National Accounts (SNA). Our research corresponds with this

international effort. This year the focus was on the international trade in environmental resources evaluated in non-monetary terms, which clarifies the international, mutual and environmental dependency and gives the environmental implications of international trade and technology transfer.

Database Management

Database

CGER is establishing the global environmental database system as well as producing and distributing UNEP/GRID global environmental data to support environmental research and decision making.

During FY 1994, the functions of the management system of the global environmental database system were expanded to include such capabilities as the recording of data utilization, data restoration and the evaluation of data. The potential of the internet as a means of worldwide dissemination of the data in our databases was also investigated. A workstation version of the data base for assessing sea level rise was developed to integrate this data with other related data available in Geographic Information Systems (GIS). "High Temporal-Spatial Resolution Marine Biogeochemical Monitoring (CD-ROM Version)" was published and distributed to users engaged in marine research.

GRID

The Global Resource Information Database (GRID) was established in 1985 in 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 UNEP/GRID Center. The major responsibilities of GRID-Tsukuba are as follows: 1) to provide a leading role in interfacing with GRID users in Japan and neighboring countries; 2) to provide datasets acquired or generated in environmental research and monitoring activities of NIES and then disseminate them to GRID users; 3) to develop GIS and remote sensing technology and to provide technical support to GRID users in the field; and 4) to promote the use of global environmental data in science and policy making.

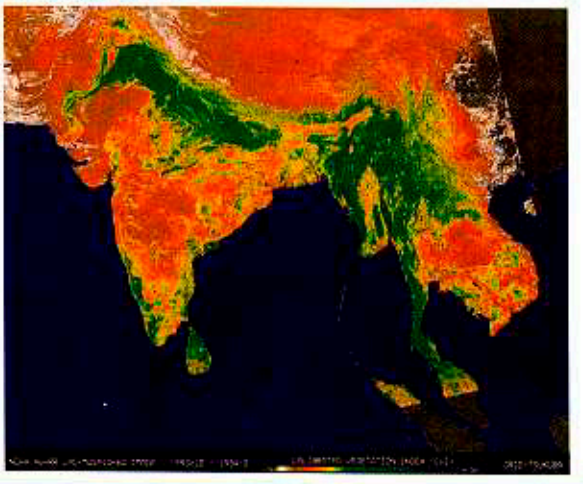


Fig. 2
Vegetation Index Map in the Asian Region. A data set produced from NOAA AVHRR satellite images. (Produced by monitoring activity. Registered to UNEP/GRID-Tsukuba.)

During FY 1994, 150 GRID datasets were distributed to users in and outside of Japan in response to about 20 requests. There were about 30 inquiries concerning the functions of the GRID-Tsukuba system and about 150 visitors to the GRID-Tsukuba office from all over the world. Two Asian vegetation index maps, for 1986 and 1993, which were produced from NOAA/ Advanced Very High Resolution Radiometer (AVHRR) images were registered as original datasets of GRID-Tsukuba and distribution to users was started (Fig. 2). Publications from GRID-Tsukuba during this fiscal year included the "GRID Data Book" and "Global Datasets: Documentation summaries".

Global Environmental Monitoring

CGER is generating data via long term monitoring and makes its data available to interested parties both directly through the publication of data reports and also by inclusion of our data in international data networks. The following 10 projects are presently being coordinated by CGER.

Ozone monitoring with ozone lidar (laser radar)

CGER is measuring the vertical profile of ozone in the stratosphere above Tsukuba with an ozone lidar. This instrument was installed in Aug. 1988 and routine monitoring of the ozone layer commenced in Oct. 1990. In FY 1994, these measurements were made on 56 days and the data will be submitted to the international Network for the Detection of Stratospheric Change (NDSC).

Monitoring of UV-B

To reveal the trend in urban ultraviolet-B (UV-B) solar radiation resulting from stratospheric ozone depletion, CGER installed a Brewer Spectrophotometer at the top of a building in Tokyo. Monitoring has been conducted since November 1993.

Atmosphere monitoring stations in Japan (Hateruma Island and Cape Ochi-ishi)

The potential for global warming due to the increasing atmospheric concentrations of greenhouse gases (GHGs) is an issue of great worldwide concern. The concentrations of GHGs at our stations are continuously monitored to determine the trends in background concentrations in Japan. Concentration data for atmospheric gases sampled at Monitoring Station-Hateruma-, the southernmost inhabited island in Japan, should be representative of background conditions in the southern Japan region. Continuous monitoring at Hateruma commenced in October 1993. To obtain atmospheric background data for the northern region of Japan, a monitoring station was constructed at Cape Ochi-ishi, Hokkaido, in June 1994 (Fig. 3).

Monitoring of GHGs in Siberian Wetlands by chartered airplane

The methane released from frozen Siberian wetlands expected to melt due

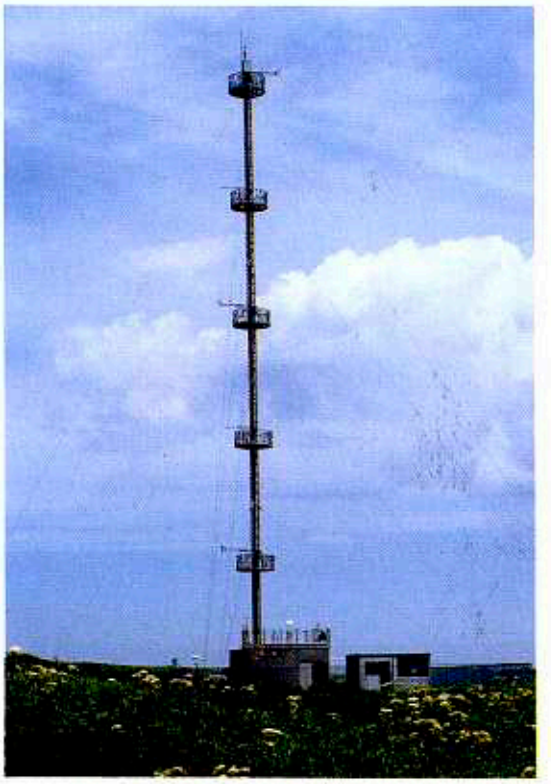


Fig. 3
Monitoring Station-Cape Ochi-ishi. In 1994, this Station constructed to obtain atmospheric background data for the northern region of Japan.

to both rapid development and atmospheric warming may accelerate global warming. CGER used an airplane to evaluate the methane flux from Siberian wetlands as a component of cooperative research projects with Russia. The plane sampled broad areas every summer for three years (1992-1994) and got unique results.

Monitoring of GHGs along a north-south transect by ship of opportunity

Routine sampling of air along a north-south transect became possible by utilizing a cargo ship crossing regularly between Japan and Australia. Such samples are now being gathered and sent to CGER's laboratory for high precision determination of GHGs such as CO_2, CH_4 and N_2O. The resulting data are useful in the study of the global carbon cycle.

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

CO_2 invasion from the atmosphere to the ocean is one of the most important carbon sinks and this process plays an important role in the global carbon cycle. To estimate the net rate of atmosphere-ocean CO_2 exchange, CGER installed instruments on a cargo ship in FY 1994 to automatically measure CO_2 partial pressures in air and surface sea water while sailing between Japan and Canada.

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

The cycles of elements such as C, N and P have been perturbed from those

in pre-industrial and pre-agricultural times. These perturbations are thought to have impacted the ocean through the marginal seas. CGER has measured Chlorophyll a, P, N, Si and pheopigments in the continuous intake of a ferry boat sailing regularly between Pusan and Kobe (1991-1993). Since Mar. 1994, the monitoring has been shifted to two other ferry lines (Osaka - Okinawa and Osaka - Beppu).

Mapping of the vegetation index with satellite data

The rapid destruction of tropical forests in Southeast Asia and elsewhere is a serious problem. Our vegetation index project uses data from a NOAA satellite to produce 1 km resolution vegetation maps of the Southeast Asia region. The resulting maps will be distributed globally through the UNEP/ GRID-Tsukuba Center.

ILAS & RIS data handling facility

The ILAS and RIS instruments will fly on the ADEOS spacecraft in 1996. CGER is responsible for establishing an ILAS & RIS Data Handling Facility (DHF) in cooperation with the Satellite Remote Sensing Research Team. The ILAS & RIS DHF will process the data obtained by the satellite instruments to prepare final atmospheric gas profiles and other data products, especially for the ozone layer. These final products will be distributed to interested parties and general users (Fig. 4).

In FY 1994, the computer system for the ILAS & RIS DHF was installed at CGER, and its operation commenced in February 1995. The full-scale development of the software system on the actual DHF computer system was initiated on the basis of a conceptual design which had been developed over the last several years.

GEMS/Water Programme

High quality fresh water is essential to the maintenance of human health. Water quality is also an indicator of environmental change. However, the standards for water quality management are rather heterogeneous among countries. A well organized global network is indispensable to maintain a consistent standard for global water management. GEMS/Water was

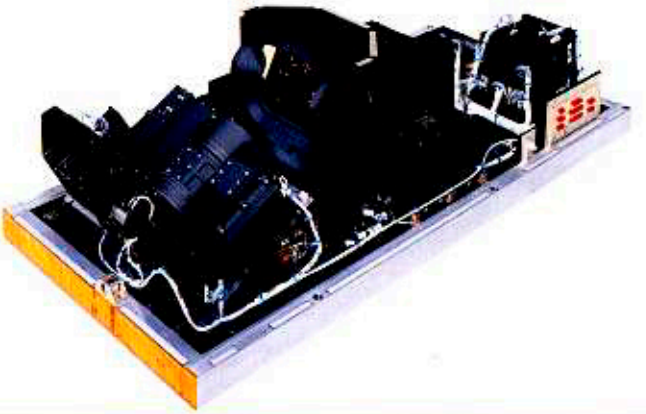


Fig. 4
ILAS Proto-Flight Model. The actual model will be aboard the ADEOS satellite. This Model was attached to the satellite and examined at National Space Development Agency (NASDA).

organized jointly under the United Nations Environment Programme (UNEP) and the World Health Organization (WHO) for this need. A network of 20 stations in Japan has been established for GEMS/Water Phase II activity. In particular, Lake Mashu with secchi disk transparency greater than 30 meters has been registered as one of the base line stations of the network. CGER is responsible for coordinating GEMS/Water data transmission, etc. as the Japanese National Center (focal point). CGER also participates in an Analytical Quality Control (AQC) Programme by providing certified reference materials (CRMs) of river sediments to laboratories analyzing samples from the global flux stations of the world.

Main CGER publications in English

Global Warming and Economic Growth [I001-'92]
IPCC Preliminary Guidelines for Assessing Impacts of Climate Change [I005-'92]
Workshop for Trace Gas Measurement in Both Hemispheres [M001-'92]
IGBP-Proceeding of Asian Symposium on Global Environmental Change [I008-'93]
The Potential Effects of Climate Changes in Japan [I009-'93]
Annual Report on Global Environmental Monitoring -1993- [M003-'93]
CGER's Supercomputer Activities Report 1992 Vol. 1 [I010-'94]
Global Carbon Dioxide Emission Scenarios and Their Basic Assumptions -1994 Survey- [I011-'94]
Climate Change: Policy Instruments and their Implications- Proceedings of the Tsukuba Workshop of IPCC Working Group III [I012-'94]
Estimation of Carbon Dioxide Flux from Tropical Deforestation [I013-'94]
Proceedings of the Tsukuba Ozone Workshop -Global Environment Tsukuba '94- [I014-'94]
IPCC Technical Guidelines for Assessing Climate Change Impacts and Adaptations (A part of the IPCC 1994 report) [I015-'94]
CGER's Supercomputer Activity Report Vol. 2 -1993- [I016-'94]
Land Use for Global Environmental Conservation -Global Environment Tsukuba '94- [I017-'95]

Staff of CGER

CGER consists of an Executive Director (Deputy Director General of NIES), a Director, Research Program Managers (5), Assistant Managers (5), Other Staff and Secretaries (10), and Guest Principal Researchers (4). Furthermore, more than 20 NIES researchers are assigned to CGER as special cooperative staff.

Environmental Training Institute

The Environmental Training Institute, until recently known as the National Environmental Training Institute (NETI) and still using that acronym, was originally established in March 1973 as the Environmental Training Center for the purpose of offering "training and practice for administrative employees under the jurisdiction of the Environment Agency." In the more than 20 years since its establishment, the institute has provided training for more than 23,000 participants from national, prefectural and metropolitan governmental organizations. In July 1990, in order to create a closer link between training and research, the center was united with the National

Public Policy Courses

Course Name	Length (days)	Number of Participants
Seminar for Environmental Bureaucratic Management/Directors	5	49
Local Environmental Training course (Environmental Management, Creating a Comfortable Environment)	8	89
Environmental Impact Assessment Training Course	6	114
Environmental Education Training Course (Government)	5	56
Environmental Education Training Course (Practicum)	3	25
Training Course for Leaders of Overseas Training Programs	8	11
Training Course for Global Environmental Conservation Technology	8	34
Nature Conservation Training Course	6	69
Wildlife Protection Training Course	5	49
National Park Management Training Course	4	26
Air Pollution Control Training Course	6	84
Noise and Vibration Control Training Course	6	77
Water Pollution Control Training Course	6	116
Information Management Training Course	8	36
Training Course for Environment Agency Employees (Section Chiefs)	5	11
Training Course for Environment Agency New Recruits (Class I Officials)	8	15
Training Course for Environment Agency New Recruits (Class II and Class III Officials)	4	13
Training Course for Newly Assigned Regional Environmental Intelligence Officers	4	13
Sub Total	105	887

Laboratory Analysis Courses

Course Name	Length (days)	Number of Participants
Instrument Analysis Training Course	13	42
General Analysis Training Course	8	26
Air Analysis Training Course	13	28
Water Analysis Training Course	13	50
Instrument Analysis Training Course (Special Program A1)	5	17
Instrument Analysis Training Course (Special Program A2)	5	14
Instrument Analysis Training Course (Special Program B)	5	9
Thematic Analysis Training Course (1) Periphyton	5	12
Thematic Analysis Training Course (2) Plankton	5	12
Thematic Analysis Training Course (3) Effluvia	5	9
Thematic Analysis Training Course (4) Benthic Fauna	5	17
Sub Total	103	237

International Cooperation Courses

Course Name	length (days)	Number of Participants
Environmental Monitoring (Water Quality) Training Course	32	10
Ground Total	240	1134

Institute for Environmental Studies, becoming the National Institute for Environmental Studies Environmental Training Institute.

The success of the Environment Agency depends in large part on unity and cooperation with all levels of government. Therefore, the organizations represented by trainees who come to the Institute and the trainees themselves vary widely in perspective and experience. National and prefectural government agencies, cities which have been established by government ordinance and 85 chartered semigovernmental corporations serve as conduits, nominating participants to the institute. Trainees from a broad spectrum of organizations all over Japan, including regional civil servants recommended by prefectures and special districts, gather at the institute.

A look at the types of organizations represented by participants in recent years reveals that trainees from prefectural and metropolitan governmental organizations are most common, comprising 70% of the total. This is followed by trainees from national ministries and government offices, comprising 20%, and the chartered semigovernmental corporations with special status, comprising 10%. Recently, the number of participants from developing nations and a few other countries has also been on the rise. In addition, the institute has started to launch activities that support the training programs implemented by prefectural and metropolitan governmental organizations and other related organizations, in response to the rapidly increasing need for training and new developments in environmental administration accompanying the implementation of the Basic Environment Law in 1993.

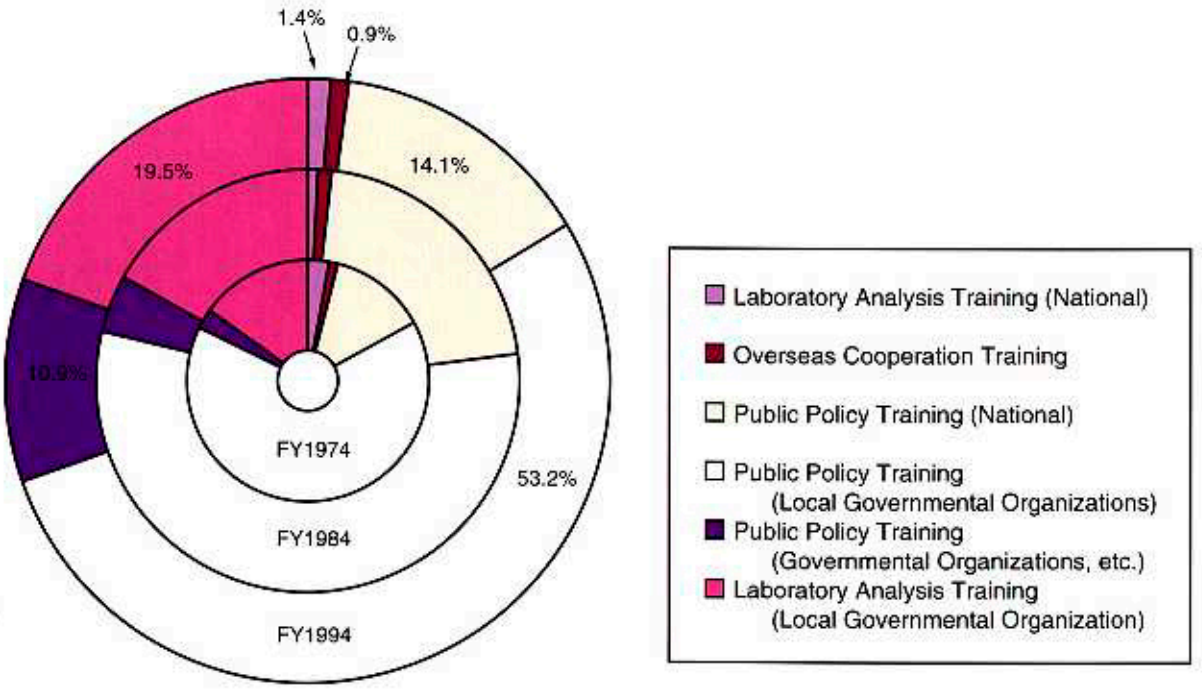


Fig. 1
Changes in the percent of participants by affiliated organization.

In order to comprehensively study the ideal structure for NETI from medium and long-range points of view, the "Investigative Committee for the Future Status of the National Environmental Training Institute" (commissioned by the Chief of the National Planning and Co-ordination Bureau of the Environment Agency) was established in February 1994. This committee is composed of experienced academics and professionals. In April 1995, the "Medium and Long-Term Prospects" white paper was completed. In the years ahead, the institute will strive to foster training and development of human resources in the environmental sector based on the guidelines proposed in this white paper.

<Global Environment Research Projects>

Mechanisms of global warming caused by the increase of greenhouse gases, Inoue, G., 1990-1994

Impacts of global warming and responses for stabilizing global climate, Morita, T., 1990-1996

Depletion of the ozone layer, Nakane, H., 1993-1995

Acidic precipitation, Satake, K., 1993-1995

Role of ocean flux in variations of the global environment and marine pollution, Harashima, A., 1990-1994

Tropical ecology and biodiversity, Furukawa, A., 1993-1995

Effects of habitat fragmentation on biological diversity, Tsubaki, Y., 1991-1995

Interaction between biotic activities and desertification in arid and semi-arid areas, Miyazaki, T., 1992-1994

Integrated studies for conserving the global environment, Nishioka, S., 1990-1996

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

<Special Research Projects>

Studies of ecosystems and environmental conservation in enclosed coastal seas, Takeshita, S., 1991-1994

Application of biotechnology to preservation of the environment and evaluation of its effects, Kondo, N., 1991-1995

Characteristics of wetland ecosystems and their stability against environmental changes, Iwakuma, T., 1991-1995

Human exposure to halogenated organic compounds and its health effects, Soma, Y., 1992-1996

Lake environment indices and nuisance picoplankton blooms, Fukushima, T., 1992-1996

Environmental health studies on stress and health effects due to environmental sounds and air pollution in highly urbanized areas, Kabuto, M., 1992-1995

Air and water pollution in an urban area caused by changes in the environmental load and countermeasures against it, Wakamatsu, S., 1993-1996

Evaluation of the risk of chronic pulmonary diseases due to diesel exhaust exposure and mechanisms of pathogenesis, Sagai, M., 1993-1997

Methodology for assessment of exposure to hazardous chemicals from waste landfills, Uehiro, T., 1994-1997

<International Joint Research Projects>

Feasibility of joint research between a research institute of a developing country and NIES in the field of environmental technology, Nakajima, K., 1993 (F/S), 1994 (F/S)

Collaboration on water pollution renovation technology in developing countries, Inamori, Y., 1994-1998

Health risks of air pollution from coal burning and risk reduction in developing countries, Ando, M., 1994-1998

Global Environment Tsukuba' 94
~ Workshop on Land Use for Global Environmental Conservation (LU/GEC) ~

Oct. 6-7, 1994
NIES, Tsukuba, Japan

The purposes of this workshop were to share the background for the need for sustainable land use, to outline the aims and tasks of the LU/GEC project and to discuss how to contribute to or cooperate with the IGBP/HDP-LUCC (Land Use/Cover- Change) and other land use/cover change research programs. There were about 110 participants in the workshop, including researchers, scientists and science managers from government agencies and ministries, national institutions and universities from Southeast Asia, Europe, Japan and the U.S.A. This workshop was organized by the Center for Global Environmental Research.

The Third Japan-U.S. Workshop on Global Change Research
~ Global Change Modeling and Assessment: Improving Methodologies and Strategies ~

Oct. 25-27, 1994
East West Center, Hololulu, U. S. A.

The topic of the Workshop was Climate Change Modeling and Assessment: Improving Methodologies and Strategies, with particular emphasis on integrative assessment of climate change. This workshop, held under the Framework of the Japan-U.S. Science & Technology Agreement, was the third in a series of Japan-U.S. Workshops on Global Change Research that have contributed to the promotion of joint research on global change and the establishment of cooperative relationships among the scientists of both countries through information exchange and discussion. There were about 80 participants in the workshop, including researchers, scientists and science managers from government agencies and ministries, national institutions and universities in both countries.

The 3rd International Workshop on the Harmonization of the Monitoring Techniques for Acid Deposition, and Methodology of Emission Inventories of SO_2 and NO_x in East Asia

Jan. 31-Feb. 2, 1995
NIES, Tsukuba, Japan

To make effective progress toward the resolution of the acid deposition problem in East Asia, we convened an international workshop for East Asian researchers. In order to agree on common methodology for emission inventory research in individual countries, we summarized additional cooperative research and data exchange which are needed to clarify the air pollution situation in East Asia.

Global Environment Tsukuba '95 ~ Tsukuba Global Carbon Cycle Workshop ~

Feb. 1-3, 1995
NIES, Tsukuba, Japan

The participants of this workshop included leading scientists who work on carbon cycle modeling, observation and process studies. The discussions were directed toward specifying the research plans necessary to achieve a consistent picture of the natural carbon cycle and the anthropogenic perturbations to it. This workshop was organized by the Center for Global Environmental Research with the cooperation of the Center for Environmental Information Science. A report was compiled under the review of the Editing Committee chaired by Prof. Taroh Matsuno.

COUNTRY
No. Title
Collaborating Institution
NIES Partner

AUSTRALIA
1. Cooperative research on global environmental monitoring
CSIRO
Water and Soil Environment Division
2. Biogeochemical studies on the trace elements in marine environments
Western Australian Marine Research Labs
Global Environment Division
3. Development of new methodologies to assess physiological effects of environmental pollutants
Department of Biochemistry, University of Tasmania
Environmental Health Sciences Division

CANADA
1. Arctic atmosphere under polar sunrise
Atmospheric Chemistry and Meteorology
Global Environment Division
2. Monitoring of the atmosphere-ocean carbon dioxide exchange rate
Center for Ocean Climate Chemistry, Institute of Ocean Sciences
Global Environment Division
3. Eco-physiological Studies on Picophytoplankton in Lakes
West Vancouver Laboratory
Global Environment Division

CHINA
1. Air pollution control
National Environmental Protection Agency
Senior Research Coordinator
2. Acid rain study in East Asia
Beijing University
Global Environment Division
3. Japan-China Cooperative Study on Environmental and Natural Resource Accounting
Development Research
Center for Global Environmental Research
4. Biogeochemical studies on acidic deposition and pollution in terrestrial and aquatic ecosystems
China-Japan Friendship Environmental Protection Center
Environmental Biology Division
5. The development of wastewater and water resources treatment processes applicable to China
Chinese Research Academy of Environmental Sciences
Regional Environment Division
6. Advanced wastewater treatment processes for China
Research Institute for Environmental Engineering
Regional Environment Division
7. Advanced soil system sewage treatment processes applicable to China
Chinese Research Academy of Sciences
Regional Environment Division
8. Industrial wastewater treatment processes and water quality renovation technology for eutrophied lakes in China
Wuhan Environmental Protection Agency
Regional Environment Division
9. Preparation and evaluation of environmental certified reference materials
China-Japan Friendship Environmental Protection Center
Global Environment Division

FINLAND
1. Accumulation of heavy metals by bryophytes in acidic environments
Department of Botany, Helsinki University
Global Environment Division

FRANCE
1. Assessment of lung injury by air pollutants
United de Biologie Moleculaire, Hospital Armand Trouseau
Environmental Health Sciences Division
2. Ozone layer observations from satellite
Laboratoire de Physique
Global Environment Division

GERMANY
1. Studies on eutrophication and related problems in closed water bodies
Federal Ministry for Research and Technology
Water and Soil Environment Division
2. Environmental specimen banking
Federal Ministry for Research and Technology
Regional Environment Division
3. Monitoring of stratospheric ozone by laser radar
Federal Ministry for Research and Technology
Global Environment Division
4. Research on the changing composition of the atmosphere
Federal Ministry for Research and Technology
Atmospheric Environment Division

INDIA
1. Air quality simulation modeling based upon tracer gas diffusion and air tracer studies
National Environmental Engineering Research Institute
Regional Environment Division

ITALY
1. Fate of pesticides in environments and their effects on ecosystems
Faculty of Agriculture, University of Milano
Global Environment Division

KOREA
1. Quantification of personal ultraviolet irradiation and its health effects
Gyeong-Sang National University
Regional Environment Division
2. Smog phenomenon and model in urban areas
National Institute of Environmental Research
Regional Environment Division
3. Promotion of environmental protection technologies
National Institute of Environmental Research
Senior Research Coordinator

4. Monitoring of ocean environmental parameters from a Japan-Korea ferry boat
   Korea Ocean Research & Development Institute
   Global Environment Division
5. Aircraft and ground-based observations of acidic and/or oxidative pollution in East Asia
   Environment Research Center, KIST
   Global Environment Division

NORWAY
1. Trophic interactions in lake and wetland ecosystems in relation to their conservation and management
   Norwegian Institute for Nature Research (NINA)
   Environmental Biology Division
2. The trophic interactions in lake and wetland ecosystems in relation to their conservation and management
   Norwegian Institute for Air Research (NILU)
   Global Environment Division
3. Global environmental database
   GRID-Arendal
   Global Environment Division

RUSSIA
1. Research Programs under the Baikal International Center for Ecological Research
   Limnological Institute, Russian Academy of Sciences
   Environmental Chemistry Division
2. Fundamental studies on the conservation of river, lake and wetland ecosystems in the Far East
   Institute of Biology and Pedology, Far East Branch
   Environmental Biology Division
3. Measurement of methane emission rates from permafrost areas
   Permafrost Institute
   Atmospheric Environment Division
4. Modeling of methane emission rates from natural wetlands
   Institute of Microbiology
   Atmospheric Environment Division
5. Airborne Measurement of Greenhouse Gases over Siberia
   Central Aerological Observatory
   Atmospheric Environment Division
6. Comparative studies on the structure of fresh water ecosystems in the Far East
   Institute of Biology and Pedology, Far East Branch
   Environmental Biology Division
7. Assessment of the effects of hazardous chemicals on aquatic ecosystems
   Irkutsk State University
   Regional Environment Division
8. Collaboration under BICER for ecological and evolutionary research in the basin of Lake Baikal
   Limnological Institute, Russian Academy of Sciences
   Environmental Chemistry Division

SWEDEN
1. Effects of increase in human activity
   Kalolinska Institute
   Environmental Health Sciences Division
2. Development of risk assessment methodologies using in vitro toxicity testing
   Department of Toxicology, Uppsala University
   Environmental Health Sciences Division

U.K.
1. In vivo NMR spectroscopy method and its application to the field of environmental health
   Department Biochemistry, University of Cambridge
   Environmental Health Sciences Division
2. Algae and Protozoa
   CCAP, Institute of Freshwater Ecology (IFE)
   Environmental Biology Division
3. Effects of environmental pollution on the metabolism of trace elements in man
   Rowett Research Institute
   Environmental Health Sciences Division
4. Solubilization of toxic heavy metals from man-made objects by acid rain
   Sheffield Hallam University
   Regional Environment Division
5. Studies on the maintenance mechanisms of biodiversity in aquatic ecosystems
   School of Biological Sciences, Queen Mary and Westfield College, University of London
   Environmental Biology Division
6. Quality assurance and international harmonization of marine environmental analysis
   Marine Laboratory, Dept. Agriculture & Fisheries for Scotland
   Global Environment Division

U.S.A.
1. Monitoring long-term change in biodiversity
   Department of Biology, University of New Mexico
   Global Environment Division
2. Development of simulation models for health risk assessment of toxic compounds
   School of Hygiene and Public Health, Johns Hopkins University
   Environmental Health Sciences Division

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).
Korea

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

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).
Malaysia

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).
Russia

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).
Russia

Memorandum of Understanding between the Indian Council of Agricultural Research and the National Institute for Environmental Studies for Collaborative Research on Desertification (1993).
India

Agreement for Collaborative Research to develop a Korean Greenhouse Gas Emission Model. Korean Energy Economics Institute (1994).
Korea

Agreement for Collaborative Research to develop a Chinese Greenhouse Gas Emission Model. Energy Research Institute of China (1994).
China

Researcher,Country, Research Period
Research Subject (Host Researcher)

Figen Var, Turkey, 1994. 4. 1~1994. 9. 30
Wind tunnel evaluation of gaseous diffusion in urban areas (Uehara, K.)

Satish Kumaran, Australia, 1994. 4. 1~1995. 1. 28
Development of bio-sensors for the detection of pollutants in environmental waters (Morita, M.)

Margarita D. Apostolova, Bulgaria, 1994. 4. 1~1995. 3. 24
Development of an isometallothionein determination method and its use for evaluation of environmental stresses (Tohyama, C.)

Dong kun Lee, Korea, 1994. 4. 1~1995. 3. 31
Development of the Korean CO_2 emission model (AIM / KOREA) (Morita, T.)

Po Sing Leung, Portugal, 1994. 4. 1~1995. 3. 31
Toxicity of environmental pollutants and development of detection methods (Tohyama, C.)

Shamil Maksyutov, Russia, 1994. 4. 1~1995. 3. 31
Development of a numerical simulation model of the global atmosphere (Inoue, G.)

Richard Weisburd, U. S. A., 1994. 4. 1~1995. 3. 31
Metabolic quotients in outdoor experimental ponds (Fukushima, T.)

Eugene M. Markin, Russia, 1994. 4. 9~1995. 3. 31
Generation of calcium carbonate by coccolithophores and its role in the ocean carbon cycle (Watanabe, M.)

James E. Nickum, U. S. A., 1994. 4. 22~1994. 9. 15
Evaluation of hydrological vulnerability in Asia (Nishioka, S.)

Douw G. Steyn, Canada, 1994. 5. 13~1995. 3. 31
Application of mesoscale meteorological models (Uno, I.)

Maria I. Moskvina, Russia, 1994. 5. 18~1995. 3. 31
Physiology and ecology of marine picoplankton (Watanabe, M.)

Kong Hainan, China, 1994. 6. 1~1995. 3. 31
Advanced wastewater treatment using a self granulation process (Inamori, Y.)

Huang Yieru, China, 1994. 6. 1~1995. 3. 31
Quality assurance of water sample analysis and evaluation of standard reference materials for the analyses. (Morita, M.)

Rokaya H. Gama, Egypt, 1994. 6. 1~1995. 3. 31
Dynamics and origin of dissolved organic nitorogen in L. Kasumigaura (Fukushima, T.)

Lee Hyung Jing, Korea, 1994. 6. 1~1995. 3. 31
Water quality management in lakes and rivers (Fukushima, T.)

Je Chul Park, Korea, 1994. 6. 1~1995. 3. 31
On the bio-degradability of dissolved organic matter (Fukushima, T.)

Noel M. Bautista, Philippines, 1994. 6. 1~1995. 3. 31
Development of an analytical method for highly volatile halogenated hydrocarbons in the atmosphere (Yokouchi, Y.)

Changyuan Tang, China, 1994. 6. 9~1995. 3. 31
Nitrate nitrogen behavior in subsurface environments (Hirata, T.)

Park Hae Kyung, Korea, 1994. 6. 15~1995. 2. 18
Water renovation using microorganisms (Inamori, Y.)

Ding Guoji, China, 1994. 6. 15~1995. 3. 31
The advanced treatment of lake water from Kasumigaura (Inamori, Y.)

Chen Xue Qing, China, 1994. 6. 15~1995. 3. 31
Health risks of air pollution from coal burning and risk reduction in developing countries (Ando, M.)

Jung Myungsook, Korea, 1994. 6. 15~1995. 3. 31
Environmental assessment of landfill leachate (Inamori, Y.)

Kim Ju Young, Korea, 1994. 6. 15~1995. 3. 31
Control of microorganisms in a biological activated carbon treatment (Inamori, Y.)

Jin Lee, Korea, 1994. 6. 17~1995. 3. 31
Policy making for Sustainable Development (Gotoh, S.)

Dustin W. Mckinney, U. S. A., 1994. 6. 17~1995. 3. 31
The Role of Veterinary Sciences in the Environmental Sciences (Suzuki, A.)

Kaul Chandra Sunil, India, 1994. 6. 20~1995. 3. 31
Toxicity of environmental pollutants and development of detection methods (Tohyama, C.)

Park Cher Hee, Korea, 1994. 7. 1~1995. 3. 31
Properties, seasonal changes and components of refractory organic substances in Lake Kasumigaura (Inamori, Y.)

Kenneth Wilkening, U. S. A., 1994. 7. 15~1995. 3. 31
Research on Acid Deposition over the East Asia Region (Uno, I.)

Xue Yanqun, China, 1994. 8. 1~1995. 3. 31
Development of a highly sensitive NO measurement method using a laser (Inoue, G.)

Chin Fu Shi, China, 1994. 8. 15~1995. 3. 31
Changes in the oxidative stress induced by exercise under UV radiation and protective function against them (Sagai, M.)

Li Renhui, China, 1994. 8. 31~1997. 3. 31
Taxonomy and phylogeny of the genus Anabaena (Cyanobacteria) and its related taxa (Watanabe, M. M.)

Uta Nitschke, Germany, 1994. 9. 1~1995. 3. 31
Comparison of the environmental policies of Germany and Japan (Nishioka, S.)

Bae Gong Young, Korea, 1994. 9. 14~1995. 3. 31
Effects of air pollutants on plants (Kondo, N.)

Isabelle Bridier, France, 1994. 10. 1~1995. 3. 31
Photochemistry and free radical kinetics related to atmospheric chemistry (Washida, N.)

Daniel Schwartzbach, Austria, 1994. 10. 25~1995. 3. 31
Development of ICP high resolution mass spectrometry and its application to environmental samples. Establishment of an analytical method for environmental samples by SIMS. (Morita, M.)

Di Sun, China, 1994. 11. 15~1995. 3. 31
Pesticide effects on zooplankton communities (Hanazato, T.)

Sunoo Sub, Korea, 1994. 12. 1~1995. 3. 31
Noninvasive diagnosis of biological function by NMR spectroscopy (Mitsumori, F.)

Lin Chung Hsin, Taiwan, 1994. 12. 15~1995. 3. 31
Effect of acid deposition on plants and soil ecosystems (Takamatsu, T.)

Navjot. S. Sodhi, Canada, 1995. 1. 9~1995. 3. 31
Wildlife conservation biology with a view point from and the relationship between population structure and genetic diversity (Nagata, H.)

Hiromi Niki, Canada, 1995. 1. 11~1995. 3. 15
International Cooperative Study of the Changes in the Atmosphere, Hydrosphere and Biosphere and their Interactions in the Arctic Region (Yokouchi, Y.)

Peng Xin, China, 1995. 1. 18~1995. 3. 31
Construction of a database of culture strains of environmental microorganisms (Watanabe, M. M.)

Cecile Rechatin, France, 1995. 1. 18~1995. 3. 31
Modeling of nutrient run off from land to ocean (Watanabe, M.)

Oleg V. Dubovik, Belarus, 1995. 2. 1~1995. 3. 31
Inversion algorithms for the ILAS radiometer (Sasano, Y.)

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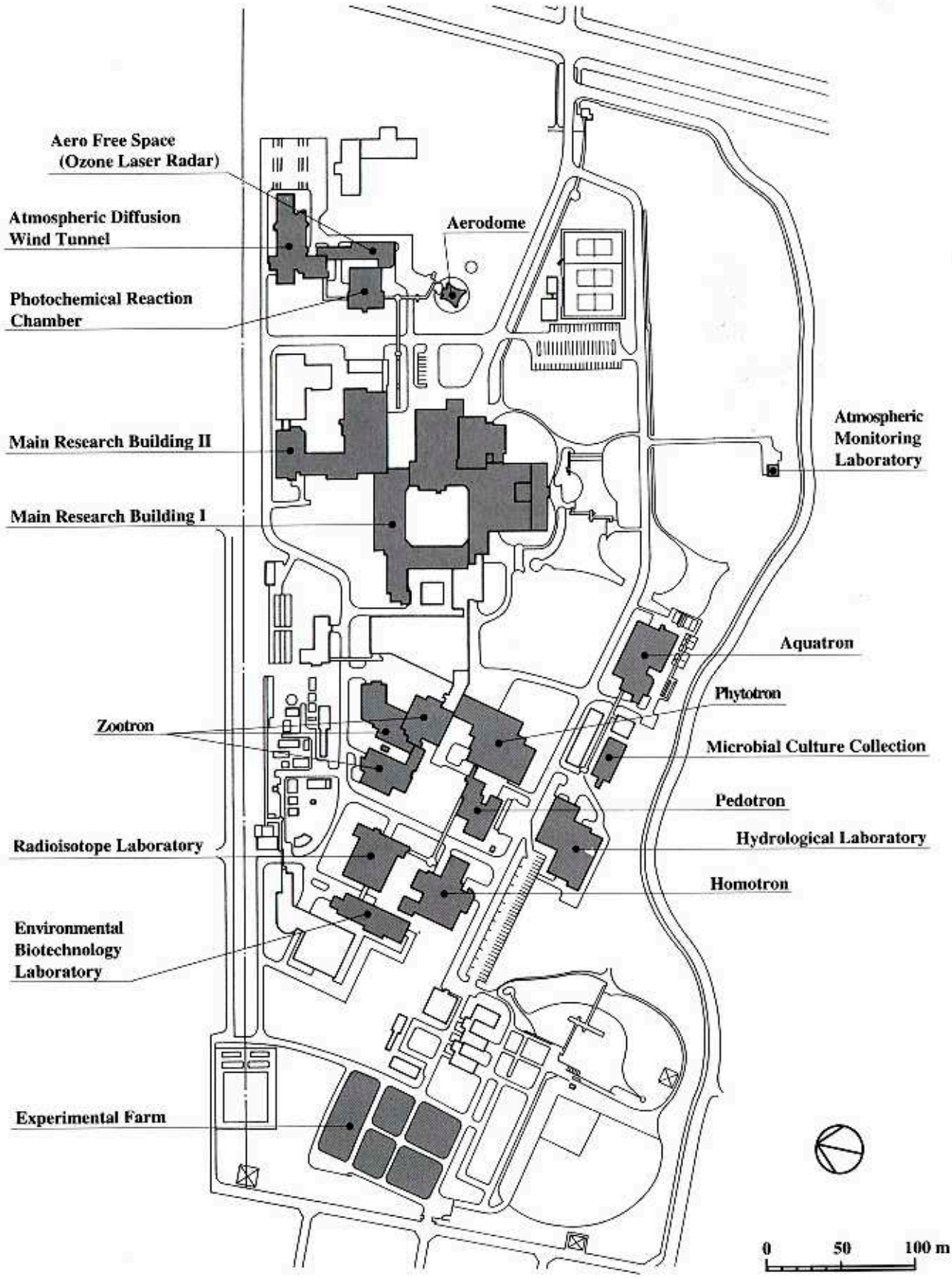
Aero Free Space
(Ozone Laser Radar)
Atmospheric Diffusion
Wind Tunnel
Photochemical Reaction
Chamber
Aerodome
Main Research Building II
Main Research Building I
Atmospheric
Monitoring
Laboratory
Aquatron
Phytotron
Zootron
Microbial Culture Collection
Pedotron
Hydrological Laboratory
Radioisotope Laboratory
Homotron
Environmental
Biotechnology
Laboratory
Experimental Farm
0
50
100 m

Research Facilities

Photochemical Reaction Chamber
This 6 m^3 stainless steel chamber 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.

Atmospheric Diffusion Wind Tunnel
This wind tunnel is exceptional in that wind velocities (down to 0.2 m/s), 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 three dimensional data. These features, together with the use of models of buildings or mountains in the tunnel facilitate the accurate simulation of air flows and pollutant transport under a variety of atmospheric conditions.

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 rapidly and sensitively scan, 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 calibrations for both lab and field experiments. It is also available for atmospheric research which can not be done in any of the other atmospheric research facilities.

Ozone Laser Radar
The ozone laser radar is equipped with three 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.

Atmospheric Monitoring Laboratory
Automatic instruments to monitor the concentrations of seven 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, solar 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 which interfere with them are studied.

Radioisotope Laboratory
Here radioisotopes 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.

Aquatron
This hydrobiological laboratory includes several related special facilities. The fresh water 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.

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.

Pedotron
This soil laboratory includes 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 studied.

Zootron
This animal laboratory's facilities are subdivided into two sections. Facility I breeds conventional and specific pathogen free laboratory animals and has complex gas exposure chambers. Environmental conditions are controlled in both facilities. 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 (NMR) for living organisms images living bodies and active metabolic functions of humans and animals.

Phytotron
This 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's two simulators permit the creation of micro environments which are stratified from the soil up through the overlying atmosphere.

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.

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 to test the psycho-physiological effects of noise on health. The Community Health Laboratory conducts epidemiological studies on humans and experimental studies on animals to evaluate the effects of environmental pollutants.

Environmental Biotechnology Laboratory
The Environmental Biotechnology Laboratory develops applications of recombinant-DNA technology for environmental protection and studies the fate and effects of recombinant

organisms in ecosystems. This laboratory was completed in FY 1993. The specialized instruments of this lab, including a peptide sequencer and a DNA sequencer, are used actively.

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 or bioremediation, to researchers at the institute.

Lake Kasumigaura Water Research Station

This field station, located on the shore of Lake Kasumigaura, is utilized 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.

Oku-Nikko Field Monitoring Station

This 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.

Main Research Building I

Main Research Building I houses analytical instrumentation and support facilities such as clean rooms. These 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 which are used for research and development of new analytical methods.

Table of Analytical Instrumentation

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 System (SAPIENS)

ELMES includes a medium size conference room which 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 record room. Environmental specimens are stored here for long periods. Research on specimen preservation is also conducted.

3) Bay Density Flow Experiment

Density flows in a bay are investigated in this apparatus consisting of a water channel which simulates a bay and the ocean to which it is attached. A wind tunnel sits above the channel.

Number of Personnel

Director General	1
Deputy Director General	1
Research Coordinator	3
International Coordination Office	2
General Affairs Division	40
Global Environment Division	23
Regional Environment Division	44
Social and Environmental Systems Division	14
Environmental Chemistry Division	18
Environmental Health Sciences Division	19
Atmospheric Environment Division	19
Water and Soil Environment Division	15
Environmental Biology Division	17
Environmental Information Center	18
Center for Global Environmental Research	9
Environmental Training Institute	18
Total	261

Field of Expertise

Physical Science	85
Engineering	40
Agricultural Sciences	20
Medical Science	17
Pharmacy	7
Fisheries Science	3
Economics	3
Total	175

Division Section/Team	Position	Staff Member	Extension	E-mail (@nies.go.jp)
Director	Director General	SUZUKI, Tsuguyoshi	2300	
	Deputy Director General	ISHII, Yoshinori	2301	ishiiy
Research Coordinators	Senior Research Coordinator	OKUMURA, Tomokazu	2302	
	Research Coordinator	AOYAMA, Ginzo	2303	aoyamag
	Research Coordinator	YAMAZAKI, Kunihiko	2304	kyamazak
	Research Coordinator	ITO, Hiroyasu	2305	h-ito
	Research Coordinator	UCHIYAMA, Hiroo	2306	huchiyam
	Research Coordinator	SUGIYAMA, Ken-ichiro	2307	kensugi
	International Coordination Researcher	UEHIRO, Takashi	2309	uehiro
	International Research Coordinator	YAMAMURA, Mitsuru	2308	mitsury
General Affairs Division				
	Director	OKADA, Hideo	2311	
General Affairs Section				
	Chief	KIDOKORO, Kazuo	2312	
Accounting Section				
	Chief	MORIYAMA, Yasuteru	2319	
Facility Section				
	Chief	MORITA, Fujitaka	2325	
Global Environment Division				
	Director	YASUNO, Masayuki	2331	m-yasuno
	Independent Senior Researcher	MURANO, Kentaro	2537	murano
Global Warming Mechanism Research Team				
	Leader	NOJIRI, Yukihiro	2499	nojiri
		TAKENAKA, Akio	2474	takenaka
		MUKAI, Hitoshi	2536	hmukaih
		MACHIDA, Toshinobu	2525	tmachida
Global Warming Response Research Team				
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		KAINUMA, Mikiko	2422	mikiko
		KAI, Keiko	2524	masuda
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		AKIYOSHI, Hideharu	2393	hakiyosi
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		HATAKEYAMA, Shiro	2502	hatashir
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		HARADA, Shigeki	2509	sharada
Natural Vegetation Conservation Research Team				
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		NAGATA, Hisashi	2493	hnagata
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Regional Environment Division				
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	INABA, Kazuho	2399	inabakz
	SONE, Hideko	2464	hsone
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	HANAZATO, Takayuki	2506	hanazato
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	TOBE, Kazuo	2486	
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Leader	TAKAMURA, Noriko	2471	noriko-t
	MIYASHITA, Mamoru	2534	
	NOHARA, Seiichi	2501	snohara

	UENO, Ryuhei	2408	uenor
	TADA, Mitsuru	2475	mtada
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	AONO, Mitsuko	2391	maono
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Chief	ARAI, Masahisa	2342	msarai
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Center for Global Environmental Research			
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Research Program Manager	KANZAWA, Hiroshi	2431	kanzawa
Research Program Manager	OTSUBO, Kuninori	2417	kuninori
Research Program Manager	FUJINUMA, Yasumi	2517	fujinuma
	GRID		grid
Environmental Training Institute			
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General Affairs Section			
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Professor	KIRITA, Kuwako		
Professor	MAKINO, Kazuo		
Professor	NAKAMURA, Yuji		

ACC	aminocyclopropane carboxylic acid
ADEOS	Advanced Earth Observing Satellite
AIM	Asian-Pacific Integrated Model
AOX	adsorbable organic halogen
APARE	East Asian-North Pacific Regional Experiment
APC	antigen presenting cell
APCI	atmospheric pressure chemical ionization
APN	Asia-Pacific Network for Global Change Research
APX	ascorbate peroxidase
AQC	analytical quality control
BICER	Baikal International Center for Ecological Research
BMMC	bone marrow derived mast cells
BOD	biological oxygen demands
CAO	Central Aerological Observatory
cDNA	complementary DNA
CFC	chlorofluorocarbon
CGER	Center for Global Environmental Research
COD	chemical oxygen demand
CPD	cyclobutane-type pyrimidine dimer
CRM	certified reference material
CSU-MM	Colorado State University Mesoscale Model
DEP	diesel exhaust particulates
DHF	data handling facility
DNA	deoxyribonucleic acid
DO	dissolved oxygen
DOM	dissolved organic matter
ESI	electrospray ionization
FA	fluctuating asymmetry
FAB	fast atom bombardment
FDDA	four-dimensional data assimilation
GC	gas chromatograph(y)
GCM	general circulation model
GEMS	Global Environment Monitoring System
GHG	greenhouse gas(es)
GIS	geographic information system
GR	glutathione reductase
GRID	Global Resource Information Database
HLAS	High-resolution Limb Atmospheric Spectrometer
HPLC	high performance liquid chromatograph(y)
ICP	inductively coupled plasma
IFN-γ	interferon γ
IGAC	International Global Atmospheric Chemistry Project
IGBP	International Geosphere- Biosphere Programme
IL-2	interleukin 2
IL-3	interleukin 3
IL-4	interleukin 4
ILAS	Improved Limb Atmospheric Spectrometer
IPCC	Intergovernmental Panel on Climate Change
LBC	limb bud cell culture
LCA	life cycle assessment
LU/GEC	Land Use for Global Environmental Conservation
LUCC	Land Use/Cover Change
MIB	methylisoborneol
MPN	most probable number
mRNA	messenger RNA
MS	mass spectro(meter)(metry)
NASDA	National Space Development Agency of Japan
NDSC	Network for the Detection of Stratospheric Change
NIES	National Institute for Environmental Studies
NMR	nuclear magnetic resonance spectro(metry)(scopy)
NOAA	National Oceanic and Atmospheric Administration
OA	ovalbumin
ODS	octadecylsilane
OPC	optical particle counters
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
PCE	tetrachloroethylene
PCN	polychlorinated naphthalenes
pTH	progenitor T-helper lymphocyte
RAMS	Regional Atmospheric Modeling System
RIS	Retroreflector in Space
RNA	ribonucleic acid
RTPSS	Regional Traffic Pollution Simulation System
SESAME	Second European Stratospheric Arctic and Mid-latitude Experiment
SIM	selected ion monitoring
SIMS	secondary ion mass spectro(metry)(meter)
SNA	System of National Accounts
SOD	superoxide dismutase
SS	suspended solids
START	SysTem for Analysis, Research and Training
STEACE	Siberian Terrestrial Ecosystem-Atmosphere-Cryosphere Experiment
TBT	tributyltin
TCE	trichloroethylene
TCEP	tris (2-chloroethyl) phosphate
TH1	T-helper-1 lymphocyte
TH2	T-helper-2 lymphocyte
TNF-α	tumour necrosis factor α
TPT	triphenyltin
UNEP	United Nations Environment Programme
UNSO	United Nations Statistics Office
UV-B	ultraviolet-B
VOC	volatile organic compounds
WHO	World Health Organization
WMO	World Meteorological Organization

Environmental Information Center
(Japanese requests only)
Phone: +81-298-50-2343
Facsimile: +81-298-51-4732

International Coordination Office
Phone: +81-298-50-2310
Facsimile: +81-298-51-2854
E-mail: kokusai@nies.go.jp

National Institute for Environmental Studies
16-2 Onogawa, Tsukuba, Ibaraki 305, JAPAN

Editorial Assistant and Printed: Environmental Research Center Co., Ltd.