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NIES Annual Report 1995



National Institute for Environmental Studies

Foreword



The United Nations Conference on Environment and Development (UNCED) 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. The Japanese government has endeavored to put the outcome of UNCED into practice. The Basic Environment Law was enacted in 1993, the Basic Environment Plan was established in 1994 and the National Biodiversity Strategy was adopted in 1995. The concept behind these actions 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 global environmental problems and the conservation of biodiversity in addition to domestic, local pollution problems. The institute is carrying out multidisciplinary research in various areas, including social sciences, such as economics, as well as natural sciences and technology, with the aim of facilitating the development of an environmentally sound society consistent with the idea behind the Basic Environment Law.

This annual report presents an outline of the research activities of NIES in FY 1995 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

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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 1995, the total number of NIES personnel was 273 (Table 1) and the total budget was 11,851 million yen (Table 2).

Table 1
Full Number of Personnel

Research	178	65.2%
Management	47	17.2%
Env. Information Center	19	7.0%
Center for Global Env. Research	10	3.6%
Env. Training Institute	19	7.0%
Total	273	100%

(as of the end of FY1995)

Table 2
Budget in Millions of Yen

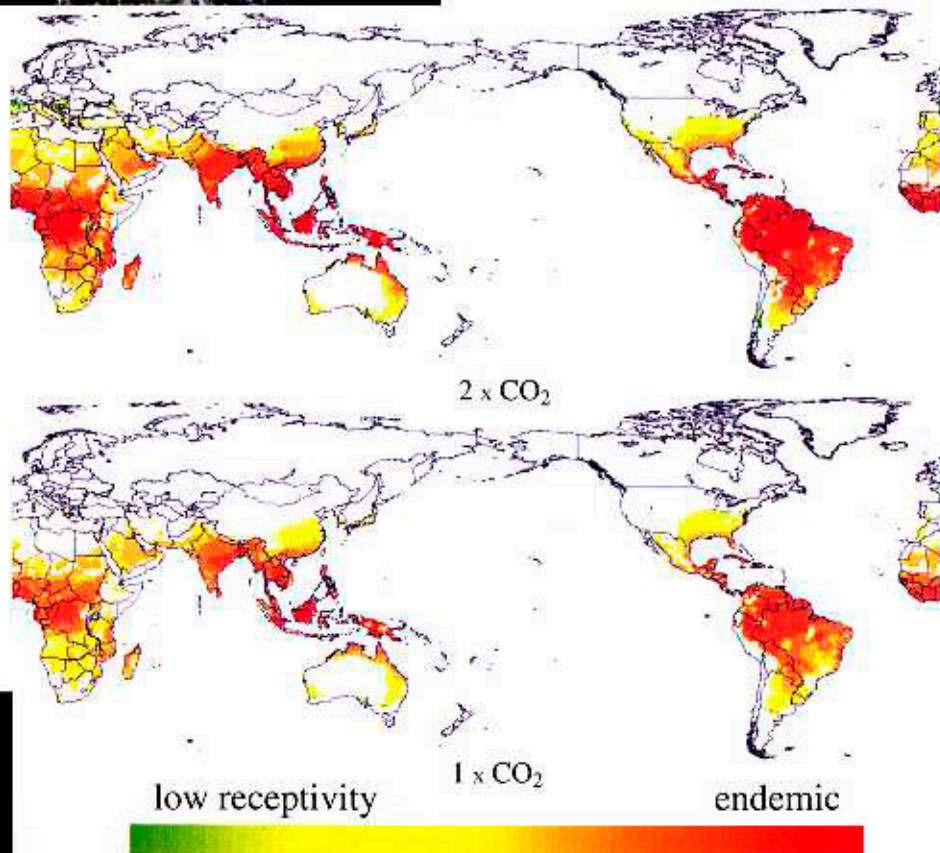
Item	FY1993	FY1994	FY1995	
1. Primary budget				(% of total)
Personnel	2,051	2,115	2,199	(21.6%)
Research	1,547	587	1,637	(16.0%)
Facilities operations & maintenance	1,312	1,290	1,457	(14.3%)
Info. & related research	387	412	509	(5.0%)
Center for Global Env. Research	1,392	1,668	1,928	(18.9%)
Env. Training Institute	99	100	108	(1.1%)
Administration	331	338	354	(3.5%)
Facilities maintenance and repairs	6,240	205	2,005	(19.6%)
Total	13,359	6,715	10,197	(100%)
2. Additional resources from external research funds				
EA Research Funds	962	1,041	1,066	
STA Research Funds	270	316	588	
Total	1,232	1,357	1,654	

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



Fig. 1
Organization of the National
Institute for Environmental Studies

Global Environment Division



The Global Environment Research Division consists of eight teams which cover major global issues. In this report, following a brief introduction of the activities of all teams, recent results from three teams are presented in greater depth.

The **Global Warming Mechanism Research Team** is measuring greenhouse gases in the troposphere and the hydrosphere, utilizing the NIES monitoring network with various platforms established by CGER/NIES, including ground based stations, ships of opportunity and aircraft. The eruption of Mt. Pinatubo is suspected of being involved in a stall in the rate of increase in atmospheric concentrations of CO₂ observed in 1992. However, the 1.5 ppm y⁻¹ rate of atmospheric CO₂ increase, measured at the Hateruma atmospheric Monitoring Station in Okinawa Prefecture from 1993 to 1995, reveals that the rate of increase has returned to levels similar to those measured during the late 1980's.

Latitudinal distributions of CO₂, CH₄ and N₂O in the atmosphere have been measured since 1992 from a ship of opportunity which sails regularly between Japan and Australia. Bottles of marine air are sampled automatically from 36°N to 25°S every 6 weeks. In addition, another ship of opportunity sailing regularly between Canada and Japan has, since 1995, been collecting data along a track from 54°N to 36°N. The results of these ship-based CO₂ and CH₄ measurements are comparable with those of the global flask sampling program. The inter-hemispheric difference in the latitudinal distribution of N₂O, 0.9 ppb, which we measured had not previously been well known. The exchange of CO₂ between the atmosphere and the ocean has been estimated for the transect between Canada and Japan. Regular measurements during 8 round trips per year provide a complete seasonal dataset for oceanic CO₂ uptake in the Northern Pacific.

Monthly atmospheric sampling from the ground surface to an altitude of 7 km has been conducted with a small airplane based at Surgut, in West Siberia. The vertical distributions of greenhouse gases provide information about CO₂ sink and source strengths of the terrestrial ecosystem and also the source strength of CH₄ from wetlands.

Many unresolved issues still surround the problem of global warming. Together with the uncertainties of natural processes such as carbon circulation, global and regional climate change and their impacts on natural resources, it is necessary to consider the many uncertainties of human activities such as population growth, economic development and technological innovation. A range of scenarios need to be prepared and various possibilities considered for use in the process of policy development.

The **Global Warming Response Research Team** is developing the Asian-Pacific Integrated Model (AIM) for scenario analyses of both greenhouse gas emissions and the impacts of global warming in the Asian-Pacific region. AIM analyzes, for example, the increasing risk of malaria caused by global warming (see panel on page 5). Increasing temperature and changing vegetation close to the ground will allow the range of the Anopheles mosquito, the malaria vector, to expand. In addition, the

malaria protozoan's development period will shorten and its reproductive potential will increase. As a result, it is predicted that the global malaria risk will rise. The model predicts that parts of North, Central and South America, Australia, China, South-east Asia, India and Africa will have increased risk of malaria infection. The area of malaria endemism will expand by 6-20%. AIM also serves as a powerful tool for projecting future climate change, acid precipitation, deforestation and other environmental changes, and assessing policy options to mitigate greenhouse gas emissions.

Ozone depletion in the middle and high latitudes of the northern hemisphere during the winters of 1994/1995 and 1995/1996 was extraordinarily large. The **Ozone Layer Research Team** has been developing ground-based remote sensing instruments and balloon-borne instruments to measure trace species related to ozone depletion and participating in national and international research campaigns such as Second European Stratospheric Arctic and Mid-latitude Experiment (SESAME) in cooperation with national institutes, universities and foreign institutions. The team is also in charge of the ozone layer monitoring effort supported by CGER. Ozone at altitudes from 15 to 45 km has been monitored for more than 7 years with a laser radar, as a component of Network for the Detection of Stratospheric Change (NDSC). In September 1995 we installed a millimeter radiometer to continuously measure vertical profiles of ozone from 30 to 70 km to extend our ozone measurement capabilities in both time and space.

In October and November 1995 the team carried out ozone sonde observations at Yakutsk (62°N, 130°E) in Eastern Siberia in cooperation with the Central Aerological Observatory (CAO) in Russia. From January 1996, ozone sonde observations were carried out to examine the influences of the polar vortex on ozone depletion at Moshiri station (44°N, 142°E), operated by the Solar Terrestrial Environment Laboratory (STEL) of Nagoya University. These observations were complemented by visible spectrometer observations from STEL, airborne FTIR spectrometer observations by the Meteorological Research Institute and aerosol laser radar observations by the Communications Research Laboratory.

Modeling of ozone depletion, including laboratory experiments to evaluate the impacts of UV-B on human and plant health. Countermeasures were also studied.

The **Satellite Remote Sensing Research Team** has been playing a leading role in promoting the Improved Limb Atmospheric Spectrometer (ILAS), Retroreflector in Space (RIS) and ILAS-II projects for atmospheric monitoring from space. The ILAS and RIS instruments will be aboard the Advanced Earth Observing Satellite (ADEOS) in 1996, and ILAS-II on ADEOS-II in 1999. Both satellites will be launched by the National Space Development Agency of Japan (NASDA). The team is responsible mainly for both the scientific aspects of the ILAS and ILAS-II projects and also for NIES's management tasks for the ILAS, ILAS-II and RIS projects.

As one of the ILAS project activities, the team has developed the first version of the ILAS Data Processing Software for daily use at the ILAS & RIS Data Handling Facility, which was built in cooperation with the CGER. The software reflects the results of the algorithm studies and the instrumental function evaluation conducted in 1995.

The team has organized a researchers' group to conduct studies and to provide scientific guidance for the ILAS project. This group consists of researchers from universities and research institutes both inside and outside of Japan. The members have been working on algorithm studies for data processing and validation experiment planning for ILAS.

The ILAS-II instrument adds new capabilities, which are not present on the first ILAS instrument, to better characterize stratospheric ozone layer chemistry and polar stratospheric clouds. The basic direction for ILAS-II data processing system development has been defined by the Satellite Remote Sensing Research Team through its data processing algorithm research and other studies.

It has been projected that by the end of the 21st century, East Asia will become the largest source of NO_x and SO_2 in the world because of its rapid population growth and development of industrial activity. The Acid Deposition Research Team is carrying out research to clarify the emissions, transportation and impacts of acid deposition in the area.

Atmospheric pollutants over the western part of the Sea of Japan and the northern part of the East China Sea were surveyed from an aircraft to evaluate the amounts of anthropogenic emission and pollutant transport. High concentrations of SO_2 and NO_x were observed over the western part of the Sea of Japan, and their distributions showed a clear dependence on wind direction. When wind blew from the west or northwest, a very high concentration of SO_2 (up to 10 ppb) was observed. The results of back trajectory analysis point to the contribution from industrialized areas in Korea. In contrast, high concentrations of SO_2 have not been detected during the aircraft flights over the northern part of the East China Sea.

Research on a conifer, *Cryptomeria japonica*, fungi and soils were carried out on the island of Yakushima, in mountainous areas of the northern Kanto region and Osorezan, a mountain in the Tohoku region on the northeastern-most portion of Japan's main island of Honshu, to understand the direct and indirect impacts of acid deposition. *Cryptomeria japonica*, having strongly acidic outer bark, seems to be acid-tolerant because it grows in naturally acidic locations as well as in neutral to slightly acidic locations. However, potassium deficiency, which is one of the causes of tree dieback, may occur in granite bedrock areas of Yakushima. Studies on soils collected from granite bedrock areas of Yakushima and sedimentary areas show relatively high concentrations of exchangeable Al in the granite soils in the form of hydrated Al^{3+} and considerable portions of the soluble Al were complexed with naturally occurring

ligands in soils. In the northern Kanto area, the detail studies are required to clarify the human-induced acidification of the environment and on the spread of a fungus, *Armillaria mellea*, which causes tree dieback.

The marine environment has been affected by anthropogenic perturbations of the elemental cycles of C, N and P and by the discharge of man-made hazardous materials. These perturbations are altering the functioning of fundamental components of marine ecosystems such as phytoplankton and coral reefs. The ocean plays a primary role in stabilizing the earth's environment. Knowledge of the extent to which man's disturbances of natural marine processes alter the sea's large physical and chemical absorptive capacities may become crucial for society. The **Marine Environment Research Team** studied material fluxes in continental shelf areas and evaluated an index of carbon flux in these marine ecosystems to clarify the interactions between marine ecosystems and global changes based on the mesocosm experiments, culture tank experiments and stable isotope techniques with emphasis on coccolithophore and bacterial activities. Two ferry lines were used as platforms to analyse long-term and seasonal changes in phytoplankton composition. The resulting data series showed a succession from diatoms to dinoflagellates, presumably because of an anthropogenically driven increase in the N:Si and P:Si ratios. We tested a continuous sampling system on the ferry between Osaka and Okinawa based on three solid phase extraction methods with XAD4, polyurethane foam and Empore filter.

A system to monitor and archive the deterioration of coral reefs was developed by two methods of obtaining underwater images: annual quadrat surveys at fixed points and extensive ship surveys with still and video cameras in towed waterproof housings.

It is now widely known that canopy gap formation and subsequent forest recovery are some of the most fundamental natural processes maintaining mature forests, including tropical rain forests. Since tropical rain forests have more complicated architectures than those of temperate or boreal zone forests and the frequency of gap formation is often higher in tropical regions, vegetation recovery in gaps of tropical forests may entail complex and specific processes. In order to understand the dynamics of forests, gap structure and recovery processes must be studied. The **Natural Vegetation Conservation Research Team** studied the vertical structure of five new canopy gaps in the Pasoh Forest Reserve in Malaysia to address these objectives. The vertical profiles of foliage density and light were measured from hemisphere photographs taken from various positions in each of these canopy gaps. These profiles are now being analyzed.

In addition, the spatial heterogeneity of light availability under the forest canopy was studied. Photosynthetic photon flux density (PPFD) was measured at 1 second intervals along a 50 cm array with 100 photo-diodes within canopies of understory plants in Pasoh, Malaysia tropical forest to characterize small-scale heterogeneity in light environments of leaves. Spatial auto-correlation analysis of the data obtained from various micro-sites revealed that: 1) daily total PPFD, diffuse PPFD and transmittance

of PPFD were highly correlated within a range of lag distances, usually less than 15 cm and 2) sunfleck PPFD varied randomly along the transects. A simulation showed that total leaf carbon gain was higher for a leaf under a spatially homogeneous rather than a spatially heterogeneous PPFD regime, when the averaged PPFD was set at a level similar to that in the tropical understory.

The first topic of the **Wildlife Conservation Research Team** is genetic diversity and fitness of rare animals. In the process of population decrease, populations may suffer a significant genetic deterioration, namely a decrease in genetic variability, which may lead to a corresponding decrease in fitness (survival and reproduction). The team analyzed the fluctuating asymmetry (FA) of several Sylvid and Emberizid species as a measure of fitness. Marginal populations were more asymmetrical than central populations of the Japanese reed bunting and Japanese marsh warbler. The degree of FA in great reed warblers was highly variable among reed beds. Great reed warblers inhabiting small and isolated reed beds were more asymmetrical because such habitats might expose birds to more environmental stress. Fluctuating asymmetry may be an effective index with which to evaluate the level of both environmental and genetic stresses.

The effect of forest disturbance on avian community structure was investigated as the second topic of the Wildlife Conservation Research Team. Avian community structure is generally closely related to vegetation structure, as the feeding technique of each bird species is a result of fine adaptation to particular types of vegetation. Monthly mist-netting has been conducted at virgin and disturbed rain forest sites in peninsular Malaysia since August, 1992. Insectivorous birds like babblers and thrushes were predominant in virgin forest, but larger babblers disappeared from disturbed forests. In contrast, the number of species and abundances of frugivorous and nectarivorous species increased in disturbed forest.

Babblers and bulbuls are suitable groups for evaluating the degree of habitat disturbance. Comparing with previous studies, it was suggested that more than 15 species may have been driven extinct from virgin forest, probably because of forest isolation and fragmentation. The effects of forest isolation on avifaunas appears to be greater than that of moderate disturbance.

Third topic of the team is termite communities as decomposers in tropical forests. The role of termites in the decay of logs in West Malaysian tropical rain forests was evaluated by comparing the changes in logs from which termites had been excluded or not (control). We then measured the rates of change in carbon (C), nitrogen (N) and phosphorus (P) masses and concentrations. The C, N and P contents of the logs were lost over two or three years, but the decline of N was slower than that of C. There were no significant differences in the rates of change of mass or concentration between the termite free logs and controls for any nutrient, site or year, indicating that termites did not affect nutrient loss during wood decay. Wood with a high density, about 1 g cm^{-3} , was more resistant to termite foraging.

Fine structure in the vertical profiles of ozone and aerosols – implication of transport from the Arctic polar vortex –

To understand the mechanisms of variation of ozone related to the polar vortex, the National Institute for Environmental Studies (NIES), the Central Aerological Observatory (CAO) and the Solar Terrestrial Laboratory (STEL) of Nagoya University carried out balloon measurements of ozone, aerosols and aerosol size distribution at Yakutsk (62°N, 130°E) in Eastern Siberia in the framework of the Second European Arctic and Mid-latitude Experiment (SESAME) in winter, 1994/1995. This report stratospheric discusses the structure of the ozone and aerosol profiles observed and their possible export from the polar vortex.

Simultaneous balloon measurements of ozone and aerosol density were carried out on January 14, February 21, March 1 and March 16 using Electrochemical Cell (ECC) ozone sondes and aerosol backscatter sondes. On March 1, an optical particle counter (OPC) was also launched using another balloon to measure the size distribution of aerosols. Yakutsk was inside the polar vortex on February 21 and March 16, outside the vortex on March 1, and at the edge of the vortex on January 14. Vertical profiles of ozone, temperature and aerosols (Fig. 1) reveal several differences between the inside and the outside of the polar vortex:

- (1) Ozone densities (partial pressure) in the lower stratosphere were high outside of the vortex and at the edge of the vortex, with peak values sometimes in excess of 200 nbar. Ozone densities were almost half these peak levels inside of the polar vortex in the lower stratosphere (15–20 km).

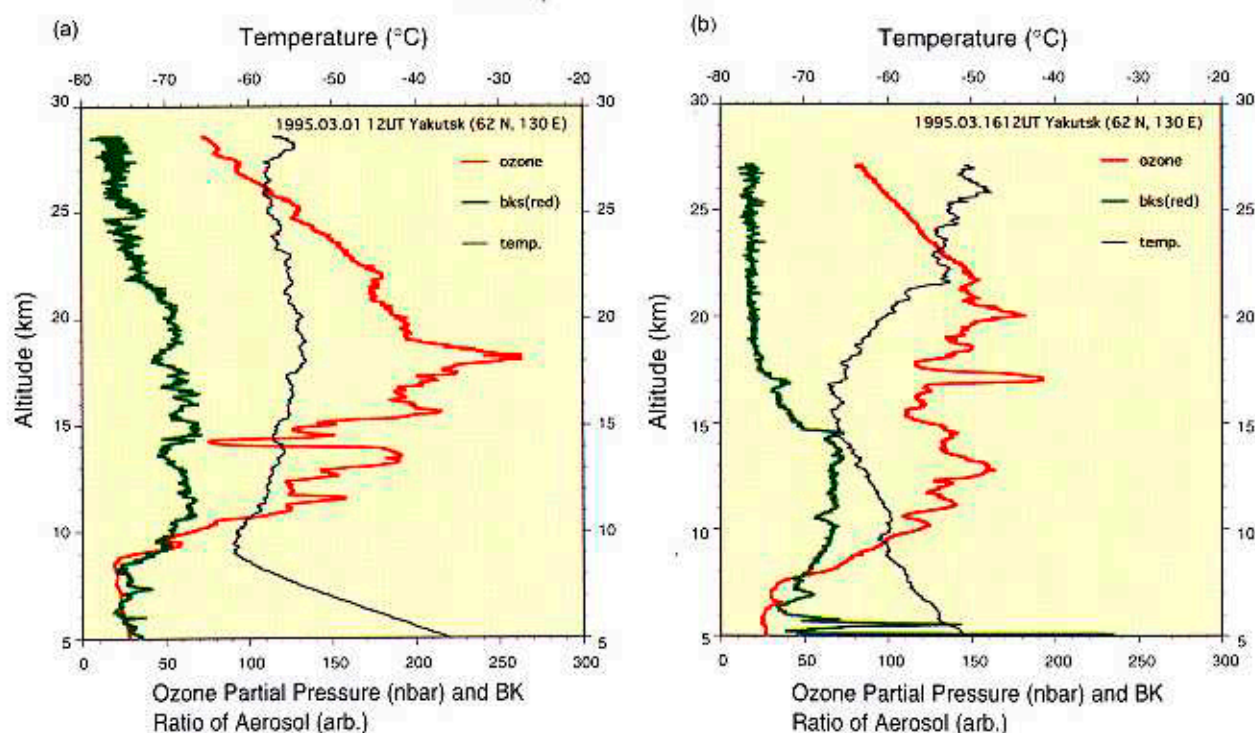


Fig.1

Vertical profiles of ozone, temperature and aerosol density simultaneously measured by balloon above Yakutsk (62°N, 130°E) on March 1 (a; outside the polar vortex) and on March 16 (b; inside the polar vortex).

- (2) Temperatures inside of the polar vortex at altitudes around 17 km was much lower than at altitudes outside of the vortex.
- (3) Aerosol densities declined rapidly above 18.5 km on February 21 and above 14.5 km on March 16 inside the polar vortex, while aerosol density (scattering ratio) decreased gradually with altitude outside the polar vortex.

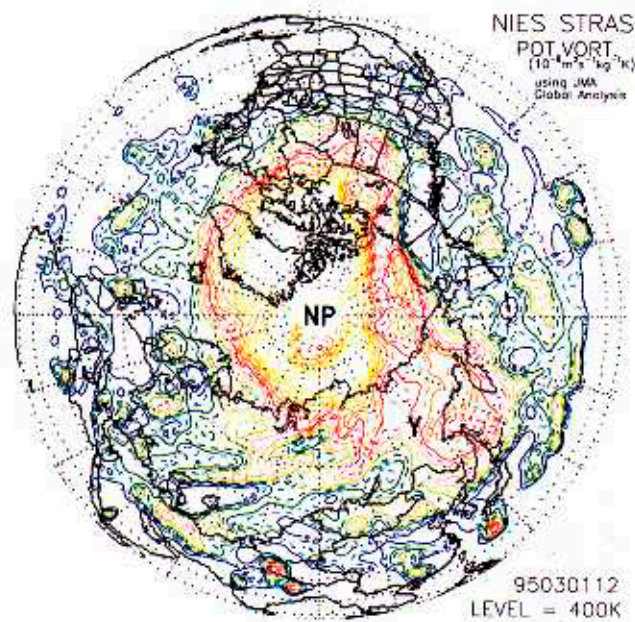
The fine structure of the ozone and aerosol profiles revealed a negative correlation between ozone and aerosols below the upper edge of the aerosol layer mentioned in (3), and a positive correlation above that layer (see Fig. 1). On March 1, the layer with low ozone and high aerosol density was clearly apparent at 14.5 km.

These observations can be consistently explained by assuming the following structures of aerosol distribution inside and outside of the polar vortex. Ozone density was lower inside the polar vortex in the lower stratosphere during winter and spring of 1995. Subsidence is one possible mechanism to reduce aerosol densities above the upper edge of the aerosol layer inside of the polar vortex. If this was the case during our observations, then the speed of subsidence can be calculated from rate of change in the height of the upper edge ($= Z_c$) of the aerosol layer between February 21 and March 16, 0.2 km day^{-1} . Polar vortex aerosol densities were lower above Z_c and higher below Z_c compared to those outside of the vortex. Therefore, there should be negative correlation between aerosol and ozone profiles outside of the polar vortex below Z_c if there is exchange of air through the wall of the polar vortex at a certain altitude. Such a negative correlation between the vertical profiles of ozone and aerosols is apparent in the data obtained on March 1, 1995 (see Fig. 1 a).

In fact, a layer at 14.5 km, with a thickness of about 1.5 km, has lower ozone density, higher aerosol density and lower temperature than those of adjacent layers. This thin layer must have come from the polar vortex. The size distribution measured by the OPC on the same day also supports this conclusion. The vertical profile of aerosol concentrations for particles with diameters larger than $3.6 \mu\text{m}$ has its peak at 14 km, while that for particles with diameters smaller than $3.6 \mu\text{m}$ has its local minimum there. This means that the air mass in this thin layer was very different from that in the adjacent layers.

Potential vorticity maps (PV maps) and backward trajectories at the potential temperature levels of 400 K (14.5 km) and 550 K (21.5 km) were made using Japan Meteorological Agency (JMA) Global Analysis data and the Stratospheric Research Assisting System (STRAS) developed at the National Institute for Environmental Studies (NIES). These PV maps (Fig. 2) do not have fine structures corresponding to the thin layer at 14.5 km. However, the boundary of the polar vortex at 400 K is obscure near Yakutsk which seems to allow small scale transport through the boundary of the polar vortex. In contrast, the boundary of the polar vortex at 550 K is clear. A backward trajectory projection from Yakutsk moved only outside of the polar vortex, implying that the JMA Global Analysis data, as well as other global analysis data, do

Fig. 2
Potential vorticity maps at the potential temperature level of 400 K (14.5 km) using JMA Global Analysis data and the NIES STRAS data analysis system.



not have sufficient vertical resolution to reproduce movements by a thin layer like that shown above. In other words, the balloon results demonstrated resolution of small scale interactions between the air inside and outside of the polar vortex.

The balloon experiment in Yakutsk during SESAME implies the existence of a process which transports air from the Arctic polar vortex to beyond it through thin layers. The role of such small scale transport processes in the interactions between air masses inside and outside of the Arctic polar vortex should be studied with further experiments using balloon, ground-based and satellite observations.

Juvenile recruitment and mortality of trees and shrubs in a lowland tropical rain forest – implications for regeneration and maintenance of species diversity –

Tropical forests vary in species richness from site to site and within plant communities. Such heterogeneity may be explained in terms of the prevalence of non-equilibrium conditions in which non-equilibrium status represents a mid-successional stage of community development. According to the non-equilibrium hypothesis, species composition and abundance of each species in a stand are determined by historical and biogeographic events that occur randomly, such as the availability of a seed source when canopy gaps are formed. Some species therefore, are fated to be absent from a site while others become established. In contrast, the equilibrium hypothesis postulates that species coexist as assemblages because each species can maintain a niche. For example, a given plant species is prevented from becoming the dominant species by host-specific predation (seed predators, herbivores and pathogens) which eliminate many individuals in the population due to density- and frequency-dependent mortality. As a result, minority species or juveniles (seeds or seedlings) are allowed to maintain a niche. Understanding the equilibrium or non-equilibrium nature of community dynamics has practical implications for conservation biologists and forest managers. If a forest is in equilibrium, the abundance of each species is expected to be constant and succession of species assemblages are relatively predictable. However, if a forest

is in a non-equilibrium state, many species may face the risk of extermination and such a loss may be detrimental if the forest area is not supplied by external seed sources. Using data obtained from a 50 ha plot of the Pasoh Forest Reserve in Peninsular Malaysia, we have analyzed the juvenile and mature tree distribution patterns and the fates of juvenile trees of major species components of the forest, to predict the extent to which equilibrium and non-equilibrium forces contribute to community dynamics.

The 50 ha plot was established and enumerated by the Forest Research Institute Malaysia (FRIM) in 1985 with supplementary funding from the National Science Foundation (USA), the Conservation, Food and Health Foundation, Inc. (USA); the United Nations, through Man and the Biosphere program (UNESCO-MAB) grants and also UNESCO-ROSTSEA, and the continuing support of the Smithsonian Tropical Research Institute (USA), Barro Colorado Island, Panama. All woody plants of 1 cm Diameter at Breast Height (DBH) or larger were measured, identified and mapped to the nearest 10 cm. The total number of trees was 335,240 of 814 species.

Juvenile density in relation to distance from conspecific adults

The initial tree census (started in 1985) data obtained in the 50 ha permanent plot were used to analyze the spatial distribution of saplings (>1, <2 cm in diameter) around conspecific adults. The minimum sizes of adult trees were defined as 30 cm for an emergent tree, 20 cm for a canopy tree, 10 cm for an understory woody plant and 5 cm for a treelet or shrub. We counted the number of saplings within a 20 m radius of each adult tree which were located at least 40 m away from other conspecific adults. Of the 814 species with more than 100 individuals recorded in the plot, 444 were chosen for the analysis. Of these selected species, the sapling densities of 48 species showed a positive linear relationship with distance from conspecific adults. In some cases, the polynomial regression curve peaked at a mid-section of the total distance from the conspecific adult ($P < 0.05$). Of these 48 species, 7 species were from the emergent layer (18.4% of the total of 38 species in this layer), 17 species occurred in the canopy layer (10.5%), 16 species were understory trees (10.1%) and 8 species were treelets or shrubs (9.4%). Among families, the Dipterocarpaceae had the highest number of species with the distribution of saplings showing a positive relationship with distance from conspecific adults. In contrast, 43 species showed a negative relationship with distance from conspecific adults and in most cases the sapling density decreased exponentially with distance. In comparison with species showing a positive relationship, only 1 species of this group was from the emergent layer (3.1% of all emergent species), 7 species were from the canopy layer (4.2%), 19 species were in the understory (11.9%) and 16 species were from the treelet and shrub layer (18.8%). We also examined whether sapling mortality is dependent on distance from adults, but found no clear relationship for these species. This result suggests that the density of individuals of these species was decreased before they reached sapling size (greater than or equal to 1 cm in DBH).

Seedlings of some species examined previously in the Pasoh forest, showed a lower survival rate in proximity to mother trees, and peak densities of juveniles shifted away from adults with time (e.g., *Pentaspadon motleyi* and *Xerospermum noronhianum*). Therefore, in some of species, the lower density of saplings in proximity to adults may be the result of intensive attack by host-specific predators or parasites. However, whether or not the 10% of species with low densities of saplings close to adults, is sufficient to contribute towards the maintenance of higher diversity remains to be proven in further studies.

New recruitment and mortality of saplings

Data from a re-census (started in 1990) were used together with the primary census data to analyze new recruitment and mortality of saplings. For each species we obtained the total number of newly recruited saplings, which were recorded in the re-census, and the number of saplings which died between the two censuses. There were significant ($P \leq 0.001$) between the recruitment rate of new saplings and the mortality of individual species for the emergent and canopy layers (Fig. 3). The relationship was not so pronounced, however, in the understory, and treelet and shrub layers ($P > 0.01$). When the species in all layers are examined, the relationship was significant ($P < 0.01$). These results indicate that in the emergent and canopy layers, the species which produce larger numbers of saplings, such as *Shorea leprosula* and *S. bracteolata*, tend to suffer high sapling mortality, while species with low recruitment show high survivorship, such as *Cynometra malaccensis*.

The indistinct relationship between sapling mortality and recruitment in the lower stories (understory, and treelet and shrub layers) indicated that there was a large

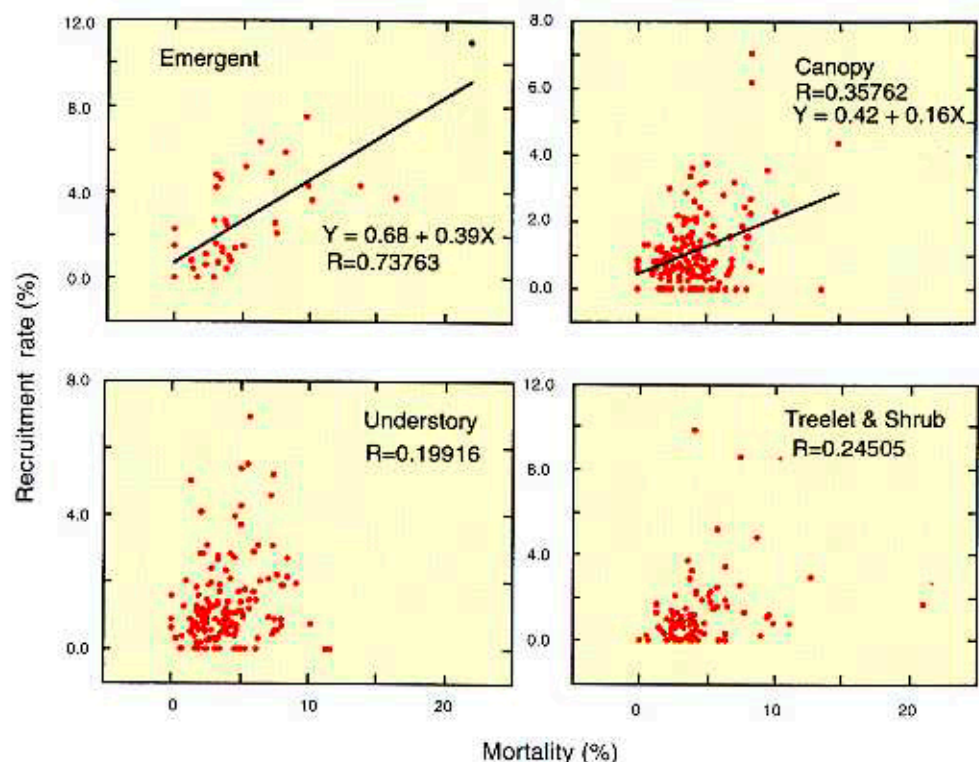


Fig. 3
Correlations between the recruitment rate and mortality of saplings of all species in each of four strata: emergent, canopy, understory, and treelet and shrub layers.

recruitment of saplings of some species in these stories and a low sapling mortality, while the converse is true for some species.

It appears that equilibrium conditions may be present in the emergent or canopy layers, but are insufficient to explain the species abundance in every forest stratum. Lower stories of the forest may not be as stable as are the upper layers in terms of the species composition, and they are probably in a non-equilibrium state. Such a conclusion needs to be considered when felling timber or constructing logging roads.

Genetic Diversity and Fluctuating Asymmetry in Wildlife

Genetic diversity can be viewed as occurring at four levels of organization: among species, among populations, within populations and within individuals. Usually we can easily distinguish genetic differences from one species to another even without knowledge about their genes. Genetic diversity among the populations of a single species is common, but usually not revealed in conspicuous characters, unless specimens are taken from geographically distant localities. Within populations of most species, all individuals look very similar, but each individual is genetically different, more or less, from every other. Genetic diversity exists even within a single individual when there are two or more alleles occupying the same locus on a chromosome. From the perspective of wildlife conservation, we should focus on the level of genetic diversity within populations.

Genetic diversity can be measured based on the distribution of different alleles among individuals and can be expressed as polymorphism (based on the proportion of genes which have more than one common allele) or heterozygosity (based on the proportion of genes for which the average individual is heterozygous). Why is it important to maintain genetic diversity within populations? In other words, why should different versions of the same gene be well distributed in a population; and why should heterozygotes be favoured rather than homozygotes?

There are two basic answers to these questions in relation to population viability. (1) Populations with greater genetic diversity are more likely to evolve in response to a changing environment than are those with less diversity. (2) Populations that lack genetic diversity may also suffer from low fitness (low fertility, high mortality, etc.) even in environments that are not changing. The first answer is comparatively simple and well documented in a number of animals and plants. However, several mechanisms for the second phenomenon are still being considered (expression of recessive deleterious alleles, over dominance, etc.).

Processes that diminish genetic diversity

Genetic diversity can be diminished by three phenomena associated with small populations. First, when a population is reduced to a small size, some genetic variance and rare genes are likely to be lost. Second, among small populations, especially those that remain small for many generations, random genetic drift changes the frequency of alleles, often reducing genetic diversity. Third, inbreeding between

closely related individuals can diminish genetic diversity.

To investigate the difference in genetic diversity among populations with different degrees of inbreeding and the effects of small population size, we used Random Amplified Polymorphic DNA (RAPD) analysis of a fish medaka (*Oryzias latipes*). Using purified DNA, random fragments are amplified using the polymerase chain reaction (PCR). Following electrophoresis, nucleic acids are stained and diagnostic bands are determined.

Medaka were found almost everywhere in rice fields throughout Japan and were popular fish. However, they are becoming increasingly rare, probably due to pesticide usage and recent alterations to the water supply systems in rice fields.

However, this fish species has long been used in studies of genetics. Consequently, many pure genetic lines of medaka have been kept in various institutes and universities in Japan. In addition, medaka have been popular as pets and can be easily purchased from pet shops. Although they are not genetically homogeneous, these store bought fish must be less variable than wild fish because they have been bred, no doubt, from a few individuals. As a result, we could easily obtain populations with three different degrees of small population effects for our genetic analysis. As we expected, electrophoresis revealed that a wild population of medaka had high levels of genetic variability, while a highly inbred population (HO5) had little genetic variability. Another population obtained from a pet shop showed intermediate levels of genetic variability (Fig. 4).

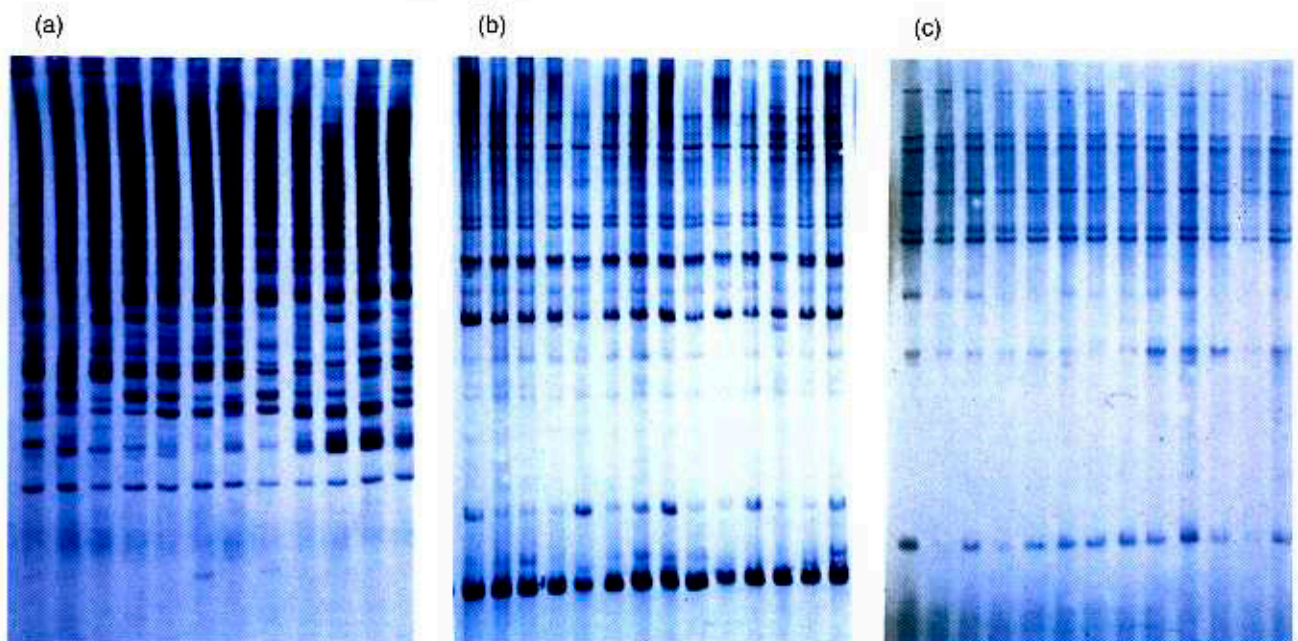


Fig. 4 Electrophoresis reveals that genetic variation is high in wild populations (a) of medaka (*Oryzias latipes*), low in an intermediately inbred population (b) and almost non-existent in a highly inbred (HO5) population (c). In this technique, randomly amplified fragments of DNA which behave like genes migrate at varying rates across a polyacrylamide gel. Each column represents an individual. Note that all individuals from the wild population have bands at different positions, while all HO5 individuals show the same band pattern because there is almost no diversity in the HO5 population.

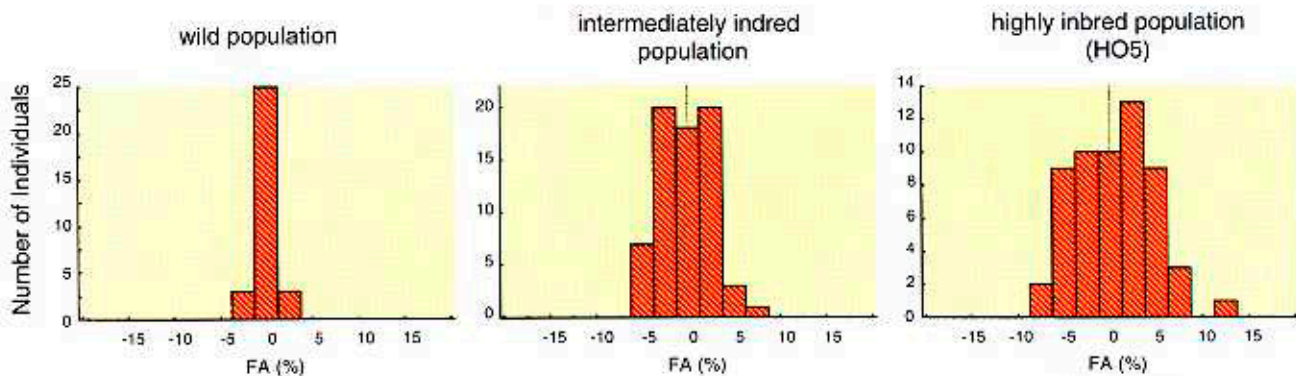


Fig. 5

Distribution of fluctuating asymmetry (FA) values for three populations of medaka (*Oryzias latipes*). The character measured was pectoral-fin length. As the average size was different between populations, FA was shown as a proportion to the average of right and left pectoral-fin lengths.

Fluctuating asymmetry as a measure of fitness

Fluctuating asymmetry (FA) is an index of minor non-directional deviations from bilateral symmetry in morphological characters. FA is widely used as a measure of developmental stability and usually increases with increasing environmental or genetic stress. Deviations from symmetry often correlate with fitness differences. Departures from symmetry are most commonly described by frequency distributions of right-left (R-L). Comparison of the degree of FA for medaka among three populations (wild, intermediate and highly indred HO5 populations) revealed that the wild population showed the smallest degree of FA and that the HO5 showed the highest FA (Fig. 5). The character measured here is pectoral-fin length. These results suggest that genetic diversity within populations stabilizes development by some unknown mechanism buffering against environmental noise, and possibly increases the viability of populations. The study of FA is a potentially valuable and inexpensive tool for detecting stress in natural and captive populations, although it will not be useful for all species or in all situations. Further studies should be made to determine which species and which characters may be useful indicators of stresses associated with population decline.

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 14 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 upon 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 transport 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 gases 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, the Regional Traffic Pollution Simulation System (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, this system predicts the impacts of various alternatives including modal shifts, changes in road network design, traffic flow control, and so on. The system was first applied to the Tokyo metropolitan area, and is now preparing 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 on Motor Vehicles to Mitigate Related Aspects of Environmental Pollution" such as environmental damage, energy consumption, accidents and congestion, began in 1994. The Eco Vehicle Project now underway consists of efforts to develop 1) A reduced size electric vehicle incorporating solar cell technologies, 2) A traffic collision prevention system which controls vehicles in response to driver commands and sensor inputs and 3) A multi-layered road design to decrease traffic congestion.

In addition, the life cycle amounts of energy consumption and CO₂ 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 NO₂, photochemical O₃ and aerosols in the urban atmosphere and to understand the relationships between changes in the relative importance of various air pollution sources and the spatial and temporal patterns of urban air pollution distribution. The team's 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 NO₂ are often observed in winter under stable atmospheric conditions, but in the Kansai area, NO₂ concentrations also increase in spring. Analysis based on our three dimensional simulation model revealed the importance of a photochemical reaction in spring. Air pollution trend analysis suggested a change in the mechanism of O₃ formation in summer in both the Kanto and Kansai areas. Recently regional O₃ maxima have been observed outside of the central Kanto and Kansai areas. This trend of geographic widening of the urban oxidant concentration maxima might be a reflection of the increases in NO_x emissions and decreases in the ratio of the concentrations of volatile organic compounds (VOC) to those of NO_x, indicating an increase in O₃ formation potential and a decrease in photochemical reactivity, respectively. To clarify these changes, an intensive field survey of the Kanto area by aircraft was conducted in August 1995. High concentrations of photochemical ozone were observed in the southern seaside area and mountain region. In addition, the team has conducted research on the similarity law for wind tunnel testing under thermally stratified flow and on technology assessment for the development of an Eco-house.

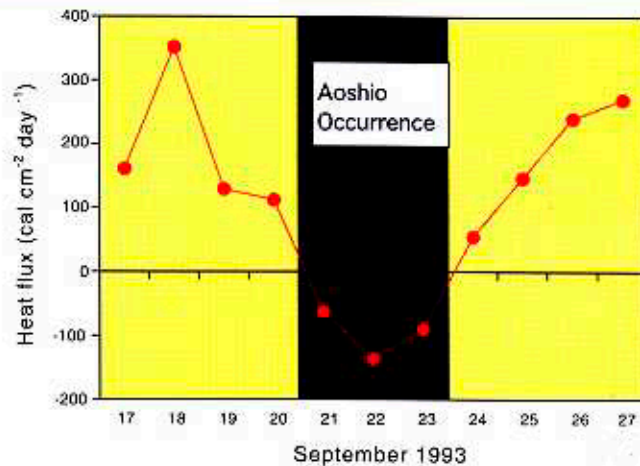
**Coastal Environment
Research Team**

This team has studied ecological problems due to eutrophication in enclosed coastal seas. One such problem is the "Aoshio" or "blue tide" phenomenon observed along the northeastern coast of Tokyo Bay during summer seasons since the 1960's, attracting public concern because of both the unpleasant smell (mainly due to H₂S) and die-offs of fish and shellfish. Aoshio events had been believed to result from upwelling of anoxic water from the bottom of the bay to the surface. The periodic observations we have conducted in the northeast sector of Tokyo Bay since 1989, suggest that vertical mixing of the coastal water column is an additional causative factor. Such mixing was enhanced by reduced temperature stratification of the water column due to surface cooling (Fig. 1). Our studies suggest that three conditions predict Aoshio formation in Tokyo Bay: 1) the existence of anoxic bottom water, 2) a continuous north wind for more than 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 over the past 5 years.

Eutrophication in enclosed coastal seas causes phytoplankton blooms, which sometimes develop into red tides. We have conducted a field survey in the Seto Inland Sea in summer to investigate the ecological roles of primary production and food webs. The major finding of 1995 was the significance of an appendicularian,

Fig. 1

Heat flux (Q_n) was calculated with the following equation: $Q_n = Q_g - Q_r - Q_l - Q_s$, where Q_g , Q_r , Q_l , and Q_s are global solar radiation, thermal radiation, latent heat, and sensible heat transfer rate, respectively; these were calculated from observed values.



Oikopleura dioica, in this ecological system. Following the collapse of a red tide, the abundance of picoplankton increased rapidly and attained a very high level. Concurrent with a subsequent sharp decrease of picoplankton abundance, the abundance and biomass of *O. dioica* increased dramatically. During this period, the growth rate of *O. dioica* was estimated to have been 1.66 day^{-1} (i.e. its body weight increased 5 fold each day). A carbon budget analysis indicates that picoplankters served as this appendicularian's main food source. *Oikopleura dioica* grew rapidly. *O. dioica* played a major role in the transfer of picoplankton production to fish and medusae.

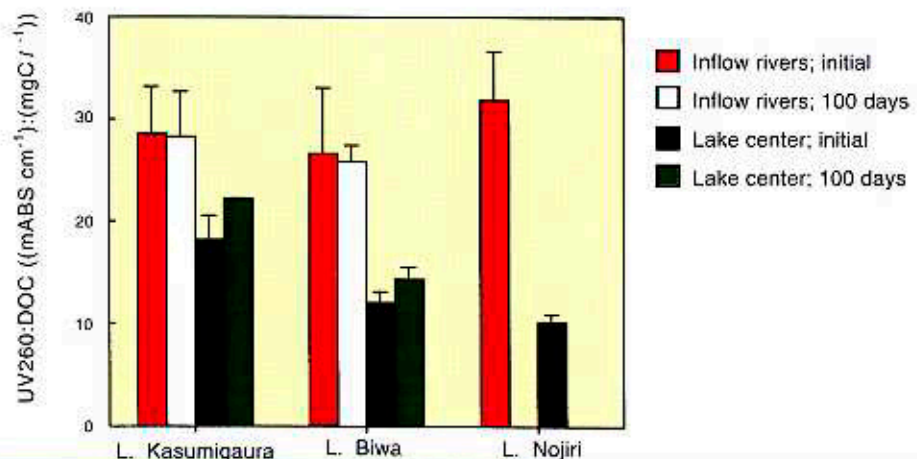
Lake Conservation Research Team

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 lakes. We sought indices of: 1) the organic matter and nutrient load generation potential of watersheds, 2) lake water quality, particularly with respect to the origin and biodegradation of organic matter, and 3) lake ecology, particularly the metabolic state of lake water and sediments, and the degree of anthropogenic perturbation. The main FY 1995 results were:

1) Significantly lower UV absorbance:DOC ratios were observed for autochthonous dissolved organic matter (DOM) in Lakes Kasumigaura, Biwa and Nojiri, compared with those for allochthonous DOM (Fig. 2); these ratios remained essentially constant throughout the bio-degradability test. This ratio is a promising candidate for an index of lake organic matter origin.

Fig. 2

The ratios of UV absorbance at 260 nm to DOC concentration in Lakes Kasumigaura, Biwa and Nojiri. Samples were measured soon after collection and after 100 days of incubation in bio-degradability tests.



2) Metabolic characteristics of lake water were determined by continuous measurements of dissolved oxygen and pH in free (uncontained) water and in light and dark boxes in which the water was exchanged at regular intervals. There was also a fairly good agreement between the observed air-water exchange flux measured with sulfur hexafluoride (SF_6) and that predicted from wind velocity.

3) An experiment with six outdoor ponds confirmed that the presence or absence of fish greatly affected phytoplankton species composition, but that primary productivity depended mainly upon levels of nitrogen and phosphorus input.

Wetland Ecosystem
Research Team
(Environmental
Biology Division)

In cooperation with the Environmental Biology Division, this team has studied the characteristics of wetland ecosystems and their resilience in the face of environmental change (FY 1991-1995). In 1995, research continued in Miyatoko and Akaiyachi Mires in Fukushima Prefecture, Kushiro Mire in Hokkaido and in Ozegahara Mire which spans the borders between Fukushima, Gunma and Niigata Prefectures.

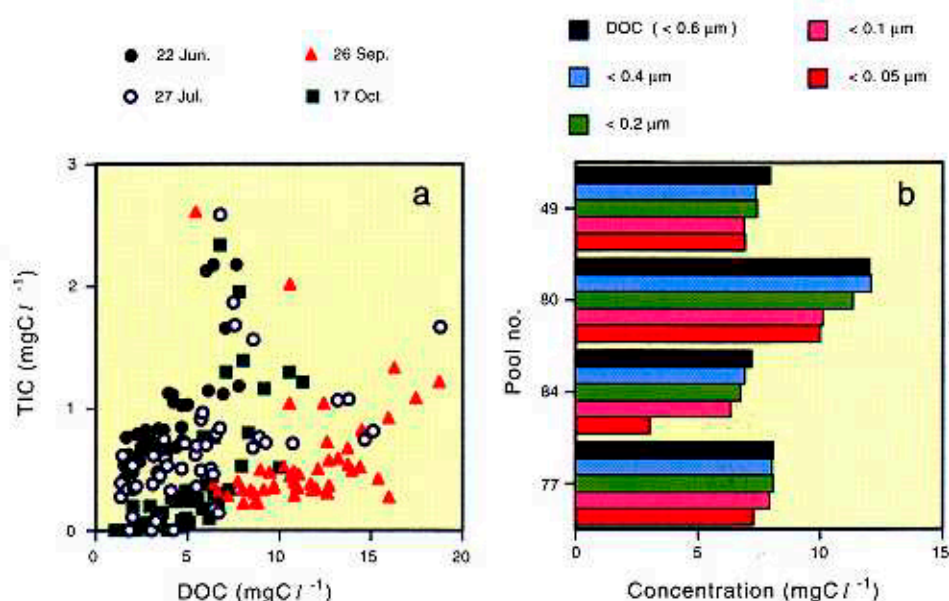
Akaiyachi Mire is a bog (a mire system fed only by atmospheric precipitation) covered with *Sphagnum* moss. Agricultural activities have posed the major threats to the mire ecosystem during the past 40 years. Mire topography, groundwater table, vegetation and plant-physiological parameters were studied along several transect lines from the periphery into the mire to estimate the effects of reclamation of adjacent area for rice paddies on the ecosystem. Based on decreases in the groundwater table, the width of the transitional zone where an edge effect penetrated into the mire ecosystem was 30 m. The transitional zone width corresponding to the distribution of a dwarf bamboo, *Sasa palmata*, was 100-200 m. The photosynthetic and evapotranspiratory rates of this dwarf bamboo and other tree leaves were high within the area 50 m inward from the mire periphery. Biological edge effects were much larger than were physical edge effects.

The physicochemical features of 50 bog pools in the Nakatashiro region of Ozegahara Mire were studied during the snow-free season in 1995. DOC, measured in filtrates which passed through Whatman GF/F filters (0.6 μm opening) and total inorganic carbon (TIC) showed distinct seasonal changes. In some bog pools, TIC decreased to 0 mg l^{-1} during the summer, and might have become the factor limiting photosynthesis by submerged macrophyte leaves. DOC and TIC varied widely among pools. A floating-leaved plant, *Nymphaea tetragona*, was abundant in bog pools with brownish water containing high concentrations of DOC and TIC. Bog-pool water was size-fractionated by filtration through nuclepore membrane filters with various pore sizes ranging 0.05-0.40 μm . The brownish materials proved to be colloidal particles of about 0.05-0.10 μm diameter (Fig. 3). These particles attenuated UV-B irradiance with a peak in absorbance at 300 nm.

Hazardous Waste
Research Team

This team has been developing 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 Institute for

Fig. 3
 (a) TIC concentrations in relation to DOC concentrations in bog-pool waters from Nakatashiro in Ozegahara Mire.
 (b) Size distribution of DOC in bog-pool water.



Environmental Studies and including 14 local government environmental research institutes, has been analyzing landfill exudates since 1994. Twelve exudates and treated drainage fluids from 7 different sites were sampled during late July and early August, 1995. The samples were gathered and homogenized at 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 pH, 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 volatile organic carbon (VOC). Over 400 organic compounds were determined, mainly by GC/MS. GC-Atomic Emission Detector (AED) analysis was performed to assist in the identification of organic compounds. GC-AED provides unique information about the atomic makeup of unknowns and is helpful in establishing the composition of a mixture from the measurements of element-specific chromatograms. Analysis of a GC-AED chromatogram of sulfur and nitrogen for the landfill leachate extract (Fig. 4) indicates the presence of tetramethylthiourea, toluene-sulfonamide isomers (#1, #3 in Fig. 4), N-ethyltoluenesulfonamide isomers (#2, #5), 2-hydroxy-benzothiazole (#4), N-butylbenzenesulfonamide (#6), and more compounds which were not among those targeted for analysis. Elemental compositions provided by GC-AED were very helpful for identifying peaks in GC/MS, and the probability of overlooking of contaminants was greatly reduced.

The results of leachate analyses done in FY 1995 are very similar to those done in FY 1994. The preliminary findings include: 1) very low concentrations of highly hydrophobic compounds such as PCBs and some chlorine-containing pesticides, 2)

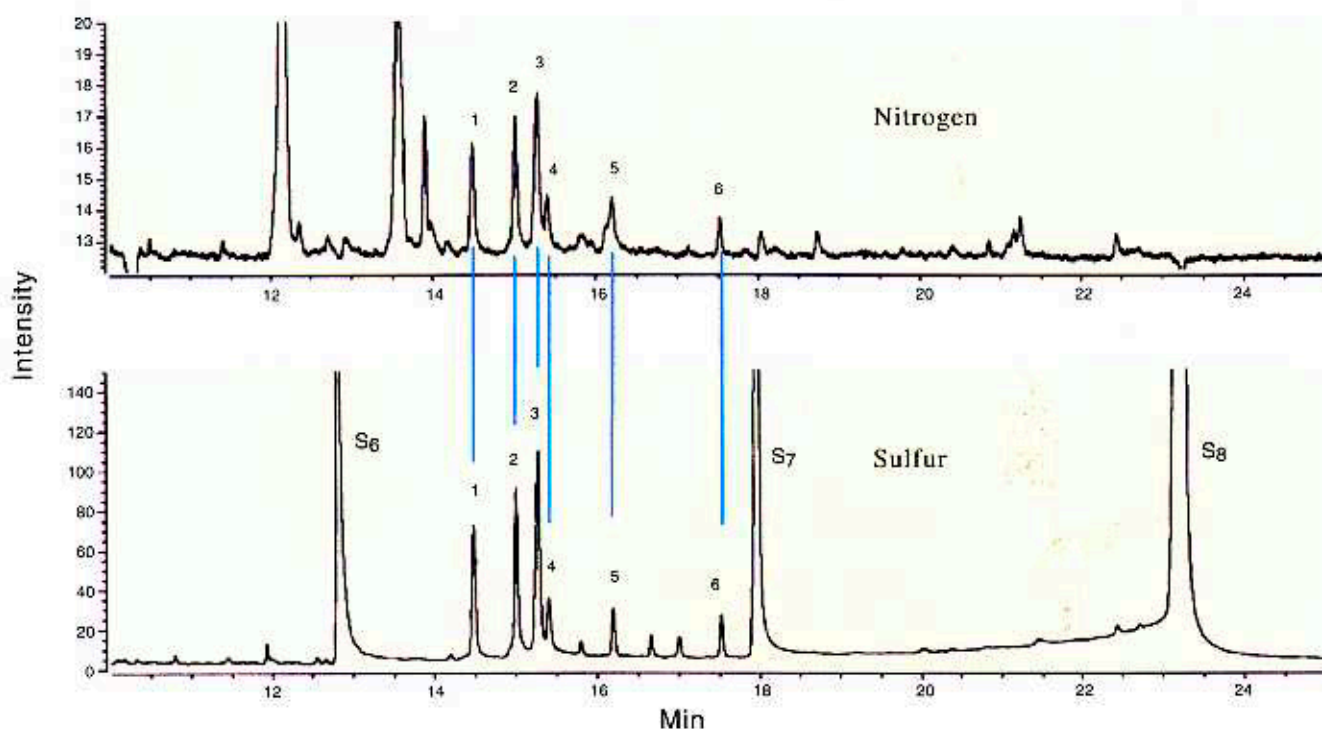


Fig. 4 GC-AED chromatogram of sulfur and nitrogen for a landfill leachate extract.

high concentrations of compounds related to plastics in some samples, 3) high concentrations of boron in some samples. There was a broad range of concentrations of many of the elements analyzed. The concentrations of iron, manganese and alkali elements differed greatly among landfill sites, whereas the concentrations of heavy metals, such as lead and copper, were similar.

Water Quality
Renovation
Technology
Research Team

This team has studied soil and groundwater contamination with hazardous chemicals. The main goals of this program are to resolve mechanisms of subsurface pollution and to develop feasible and cost-effective remediation technologies. 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 one order of magnitude more effective at removing trichloroethylene than is groundwater extraction. However, groundwater extraction becomes more effective as the remediation progresses due to changes in the subsurface environment, pointing out the importance, from the cost-benefit point of view, of implementing appropriate remediation strategies and, in particular, of maintaining the flexibility to change the remediation techniques in correspondence with changes in the state of contaminants in the subsurface environment.

In addition to organochlorine contamination, our team also analyzed the concentration of nitrate 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 ($\delta^{15}\text{N}$) was measured to resolve the origin of the nitrate detected

in regional groundwater. Cluster analysis of these results suggests that the groundwater sampled from paddy fields contained less than 10 mg l^{-1} nitrate-nitrogen, while groundwater from upland fields contained more than 10 mg l^{-1} . Furthermore, the nitrogen isotopic weight decreased with increasing nitrate concentration in the paddy groundwater and remained between 4.6 and 7.3‰ in the upland groundwater. Such trends suggest that nitrate from chemical fertilizers applied to farm land may be leaching into groundwater.

**Air Pollutants
Health Effects
Research Team**

This team has experimentally studied the mechanism of pathogenesis and evaluated the risk of chronic pulmonary diseases due to diesel exhaust particles (DEP) and diesel exhaust (DE).

Subthemes include: 1) clarification of 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 and 4) evaluation of the risks of posed by diesel exhaust to human health.

FY 1995 research clarified the mechanisms of asthma pathogenesis caused by repeated intratracheal administration of diesel exhaust particles (DEP) and ovalbumin (OA) as an allergen. The intratracheal administration into mice increased the concentration of interleukin-5 (IL-5) and granuloma macrophage-colony stimulating factor (GM-CSF) in lungs, and IgG1 antibody in serum, but not IgE antibody. IL-5 and GM-CSF, which were produced by Th2 lymphocytes, are important cytokines which induce the infiltration of eosinophils into lungs. IgG1 binds onto Fcγ RII receptor on eosinophils, stimulating the eosinophils to release toxic proteins such as MBP, EPO and ECP. These toxic proteins cause airway epithelial cell damage and chronic airway inflammation, thereby inducing airway hyperresponsiveness. A possible mechanism of asthma pathogenesis caused by intratracheal administration of DEP and ovalbumin (OA) is illustrated in Fig. 5.

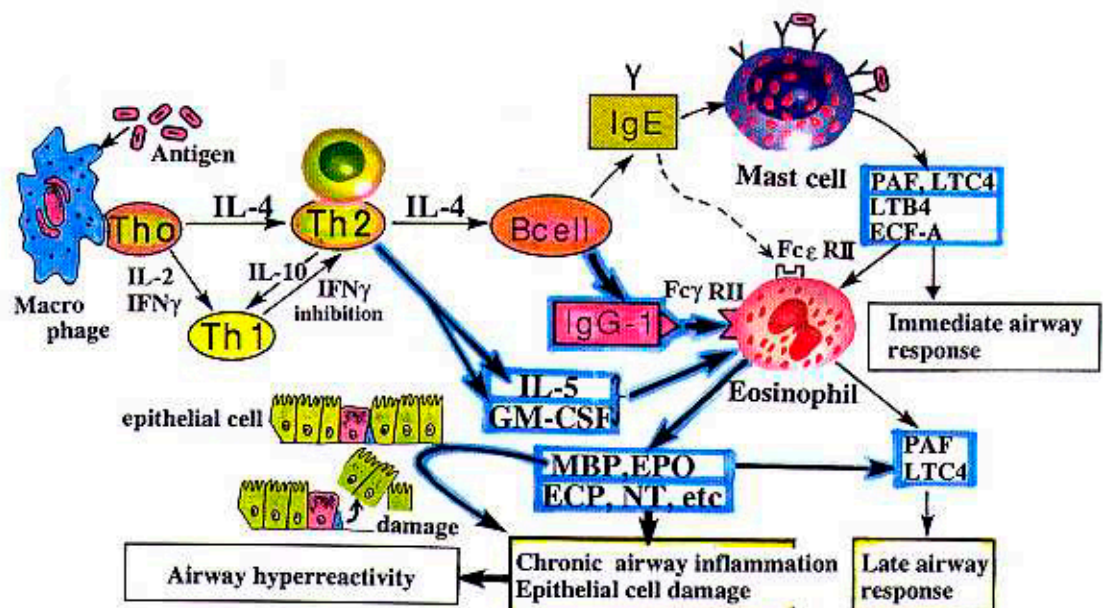


Fig. 5
A possible mechanism of asthma pathogenesis by intratracheal administration of diesel exhaust particles (DEP) and ovalbumin (OA) in mice.

Chemical Exposure
and Health Effects
Research Team

The effects of high dietary fat and β -carotene on lung carcinogenesis induced by intratracheal administration of DEP were investigated previously. This year, the formation of 8-hydroxydeoxyguanosine (8-OHdG) in lungs was examined with the same experimental system as was used previously. We found that there is a very tight relationship between tumor incidence and 8-OHdG formation. This evidence suggests that lung tumors induced by DEP administration may be caused by hydroxyl radical generated from DEP.

This team is systematically studying human exposure to halogenated organic compounds which have been released into the environment and assessing the associated health risks. The fates of these chemicals in the environment and their health effects through environmental exposures will also be studied. The following two major results were obtained FY 1995:

1) Total emissions and releases of chlorinated organic compounds to the Japanese environment were estimated from national production. Chlorinated compound production was divided into volatile, semivolatile, organic polymeric and inorganic compounds (Fig. 6). More than half of the organic chlorine is produced as polymers such as polyvinyl chloride, but volatile compounds contribute the largest amount of emissions. Furthermore, if all of the discarded polymers were incinerated, then the formation and release of organic chlorinated compounds from the polymers should have been small. The formation of chlorinated organic compounds through sterilization or bleaching with molecular chlorine or other inorganic chlorinated compounds is significant, and results in the release of higher concentrations into water and sediments in urban regions.

2) Toxicities of nine organochlorine compounds commonly detected in river water and sediments to 3 different cell cultures, nerve cells, immobilized rat hepatocytes and rat embryo limb cells, were evaluated. The toxicities of most of the compounds were similar in all 3 cell culture systems. p-Chloroaniline was more toxic to nerve cells and hepatocytes than was 3,4-dichloroaniline, but less so to limb bud cells. 2,5-Dichlorophenol showed specific toxicity to cell differentiation of limb bud cells. Incorporation of neutral red into nerve cells was specifically inhibited by 2,5-

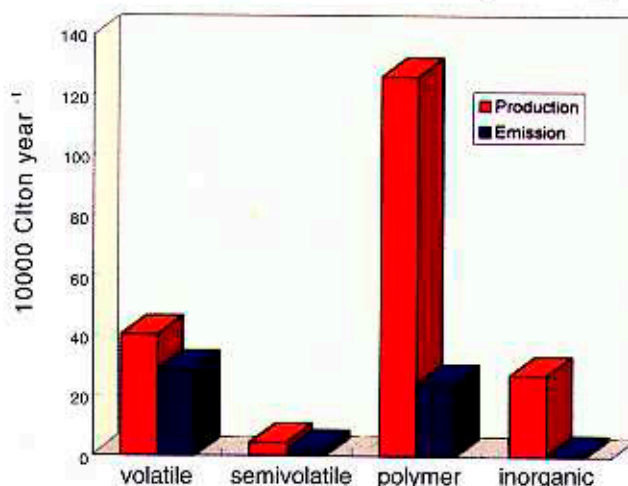


Fig. 6
1990 production and emission of chlorinated compounds in Japan. Emissions were estimated from production.

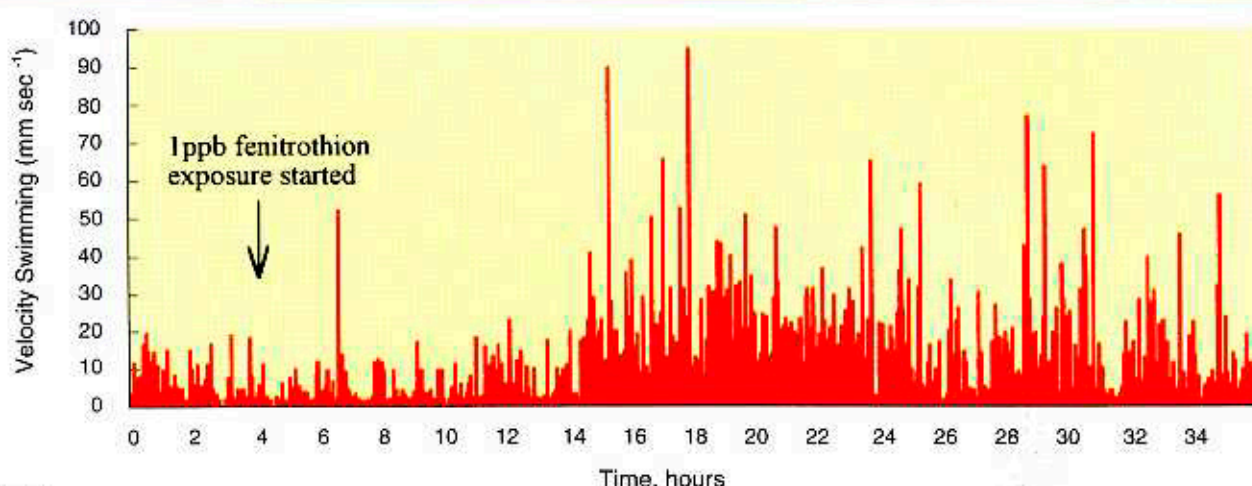


Fig. 7 Temporal change in mean swimming velocity (n=10) of the freshwater shrimp (*Paratya compressa improvisa*) exposed to 1 $\mu\text{g l}^{-1}$ fenitrothion in a flowthrough aquarium.

dichlorophenol and dichloroanisole, suggesting specific toxicity of these two compounds to lysosomal function. A good correlation was observed between IC₅₀ observed in rat immobilized hepatocytes and no observed adverse effect level (NOAEL) for chlorine hepatotoxicity in vivo.

Ecological Hazard
Assessment
Research Team

This team has studied the development of efficient biomonitoring methods for assessing the impacts of chemical substances on aquatic ecosystems. An insecticide susceptible strain of chironomid, *Chironomus yoshimatsui*, and a freshwater grass shrimp, *Paratya compressa improvisa* were selected as the biomonitoring test organisms. Toxicants may induce behavioral responses by aquatic organisms at levels much lower than lethal concentrations. An image analyzer apparatus was developed to record temporal changes in the mean swimming velocity of several aquatic organisms, such as the freshwater shrimp mentioned above and zooplankton (*Daphnia magna*). Changes in the time for a behavioral response and mean swimming velocity of the shrimp upon exposure of to an insecticide, fenitrothion, at several concentrations at the level of several ppb were successfully monitored (Fig. 7).

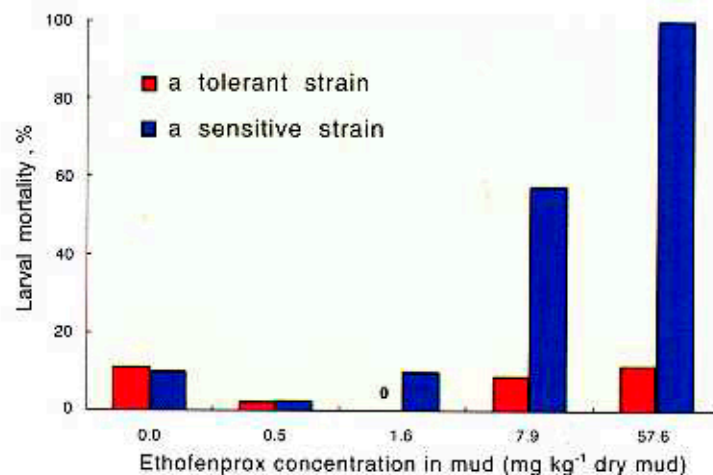
Test methods were developed to assess the effects of toxicants bound to sediment using chironomid larva and the freshwater shrimp cited above. Lake Kasumigaura sediment was contaminated in the laboratory with ethofenprox, an prethroid insecticide, and introduced into a flow-through aquarium supplied with clean water. Depending on the insecticide concentrations in the sediment, high mortality (-100% within several days) of the test organisms lasted for a long time even in the flowthrough aquarium (Fig. 8).

Biotechnology
Products
Assessment
Research Team

This team has studied the applicability of biotechnology to preservation of the environment and the risks of this approach. The approach is to produce transgenic organisms useful for preservation of the environment and then to evaluate their impacts.

The relationship between ethylene, a plant hormone, and the response of plants to air pollutants has been studied. The rate of ethylene evolution by tomato plants was

Fig. 8
Mortality of insecticide tolerant or sensitive strains of midge larvae, *Chironomus yoshimatsui*, exposed to ethofenprox (an insecticide) contaminated lake sediment for 1 week in a flowthrough aquarium.



rapidly increased by ozone fumigation. The time course of an increase in 1-aminocyclopropane-1-carboxylic acid (ACC) synthase activity was the same as that of the rate of ethylene evolution, suggesting that ACC synthase activity might be a rate-limiting step in the ethylene evolution induced by ozone fumigation. Pretreatment of leaves with aminoethoxyvinylglycine (AVG), an inhibitor of ACC synthase, significantly inhibited ozone induced ethylene evolution and concomitantly reduced the extent of visible damage to leaves. Treatment with 2,5-norbornadiene, an inhibitor of ethylene action, reduced the extent of the visible damage caused by ozone. Therefore, ethylene seems to be involved in certain metabolic processes which cause visible damage. A cDNA clone of the gene encoding ozone-inducible ACC synthase in tomato is being isolated.

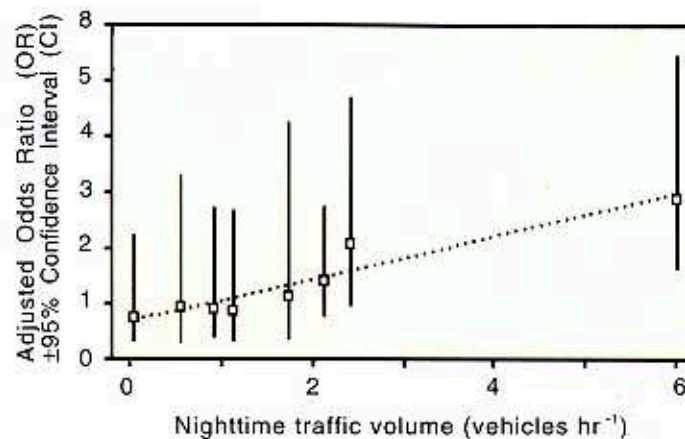
The survival of wild-type and genetically engineered *Pseudomonas putida* Ppy101 containing a recombinant plasmid, pSR134, conferring mercury resistance were monitored in aquatic microcosms with lake, river, and spring water samples. The rates of population change of these strains were not significantly different. Inoculation of genetically engineered or wild-type *P. putida* had no apparent effect on the density of indigenous bacteria.

Urban Environmental 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”).

The relationship between insomnia and chronic sleep disturbances and indoor noise levels from nighttime road traffic has been investigated with a survey of 3,600 randomly selected middle-aged women (20-80s years of age) from 8 areas, where major roads pass with various traffic volumes, in Tokyo, Gunma, Nagasaki and Okinawa. Of those surveyed, 403 (11%) had experienced insomnia, defined as a state with 1) difficulty falling asleep, 2) waking during sleep, 3) waking early and 4) feeling insufficiently rested in the morning, which has lasted for the last one month or longer. Results were expressed as the ratios (odds ratios; OR) or prevalence rates for various test groupings to those for similar control groups whose homes were located

Fig. 9
ORs of roadside zones
(0-20 m) in 8 areas as a
function of nighttime
traffic volume.



20 m or more away from roadways. The age-specific prevalence rate was lowest among those in their thirties and highest in the oldest group. Multiple logistic analyses revealed that those participants older than 70 years, undergoing medical care or having experienced significant life events during the preceding 6 months were significantly and consistently associated with increased risk of insomnia with ORs of 1.7, 2.3 and 3.0, respectively. When the above associated factors were accounted for, the ORs for 8 roadside zones were well correlated with nighttime traffic volumes (Fig. 9). The highest prevalence rate, 21%, was observed in one of two Tokyo areas with nighttime traffic volume of around 1800 vehicles hr⁻¹. In contrast, the prevalence rates in reference zones 20 m or more away from roadways were fairly consistent at around 9%.

The over-all prevalence of Japanese cedar pollinosis in the 1993 season in 5 areas surveyed ranged from 17.8 to 24.4%. 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 both serum specific-IgE and total IgE. Annual changes and areal differences in the rates of prevalence at least at the population level, seem to be largely dependent on pollen exposure and do not seem to have been affected significantly by air pollution, in particular by diesel exhaust. Another consistent major finding in a series of examinations following the initial 1993 study is that current smoking is inversely associated with the proportions of subjects with specific-IgE levels and with pollinosis symptoms in season, suggesting that the observed low immunological sensitization among current smokers might have important implications for further experimental as well as clinical studies.

In addition to these epidemiologic studies, the team has been conducting other epidemiologic studies of breast and gastric cancers, experimental studies on humans to develop biological indicators to evaluate stress, as well as neurotoxicological experiments focusing especially on the hippocampus as a center of stress response.

International Water
Environment
Renovation
Research Team

This team has studied eutrophication of lakes, reservoirs and rivers, and countermeasures against it, especially nutrient removal from wastewater by specific microorganisms. Increases in the total N/P ratio caused blooms of harmful, toxin producing picoplankton and cyanobacteria 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, an 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 use of bio-films for water treatment has also been developed and applied to domestic water treatment in industrialized as well as in developing countries such as Thailand and the Philippines. These processes are expected to efficiently decompose anthropogenic contaminants, such as trichloroethylene, and naturally occurring toxicants, such as microcystins.

The effects of chemicals, microbial pesticides and genetically engineered microorganisms in aquatic ecosystem have been estimated with an environmental assessment method using a flask-size microcosm system consisting of decomposers (bacteria), producers (algae) and consumers (protozoa, metazoa).

International Health
Effects Research
Team

This team has assessed health risks associated with air pollution from coal burning in Asia-Pacific countries, such as China, and will evaluate possible risk reduction strategies. International cooperative research on exposure assessment for both outdoor and indoor air pollution from coal burning has been carried out in China. Elevated levels of atmospheric pollutants from coal combustion were found in both indoor and outdoor air.

Furthermore, special attention has been paid to airborne fluoride pollution from coal,



(a)



(b)

Fig. 10
Health survey of (a) dental fluorosis and (b) skeletal fluorosis in endemic fluorosis areas in China.

since it has been reported that endemic fluorosis has been caused by coal burning. This research group has assessed exposure to airborne fluoride and the incidence of dental (Fig. 10 a) and skeletal fluorosis (Fig. 10 b). In 14 provinces, 18 million people are suffering from dental fluorosis and 330,000 are suffering from skeletal fluorosis by coal burning.

International Ecosystem Management Research Team

There are more than 300 cyprinid species, including many endemic species, in the middle and lower basins of the Yangtze River in China. In the past, lakes in these watersheds and the Yangtze River were connected, allowing the fish species of commercial importance to move around. However, over the past decades, natural resources in these areas have been damaged and lake ecosystems have been changed by severance of the lakes from the river by construction of dikes and dams, accelerated eutrophication and chemical pollution. This project's aim is to define sustainable levels of utilization of these lakes at which this region's biodiversity can be maintained.

We started by investigating water quality and communities of aquatic organisms in Lake Dongtin and Lake Dong in the Yangtze River Basin. Lake Dongtin is one of only two lakes which remain connected to the Yangtze River. Lake Dong, located in Wuhan City, was cut off from the Yangtze River in the 1960's. Both Lake Dongtin and Lake Dong are hypertrophic lakes, with TP higher than those found in Japanese lakes including hypertrophic Lakes Kasumigaura and Suwa (Fig. 11). The chlorophyll a concentrations of the Chinese lakes were lower than those of Japanese waters despite high TP levels (Fig. 12). These data suggest that aquatic environments in China may be quite different from those in Japan.

Independent Senior Researchers

In addition to the above mentioned 14 research groups, 3 independent senior researchers are working in specialized areas including environmental statistics, ecosystem Preservation and environmental policy-making in developing countries.

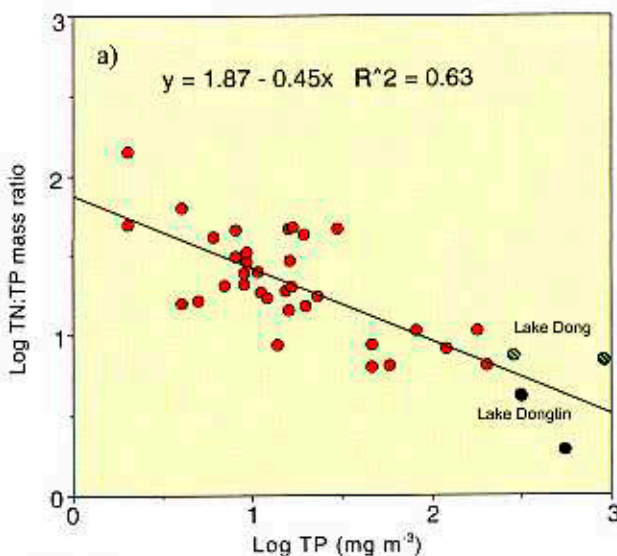


Fig. 11 Relationship between total phosphorus concentrations (TP) and TN:TP ratios of the euphotic waters of 34 Japanese lakes and 2 Chinese lakes.

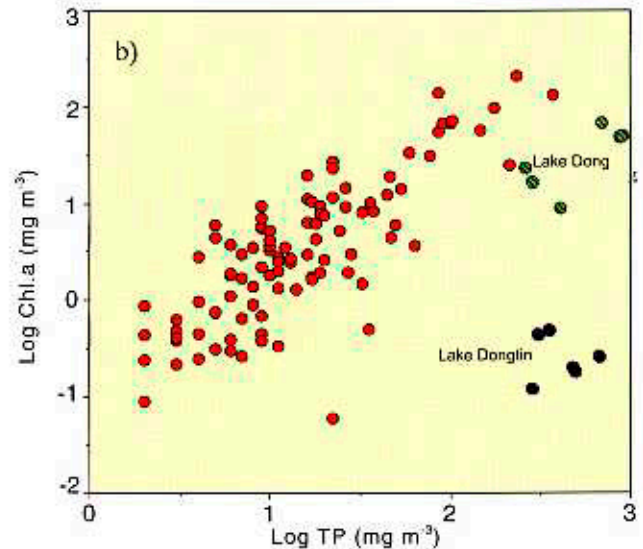
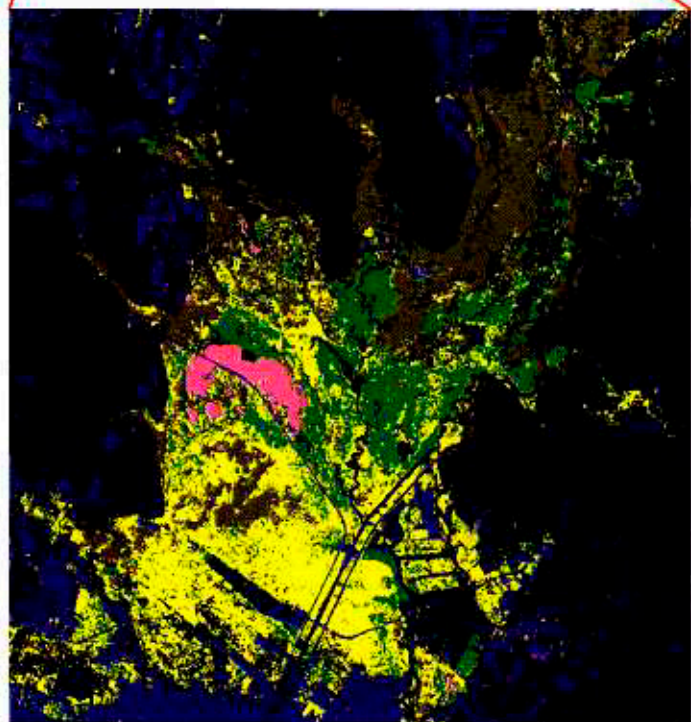
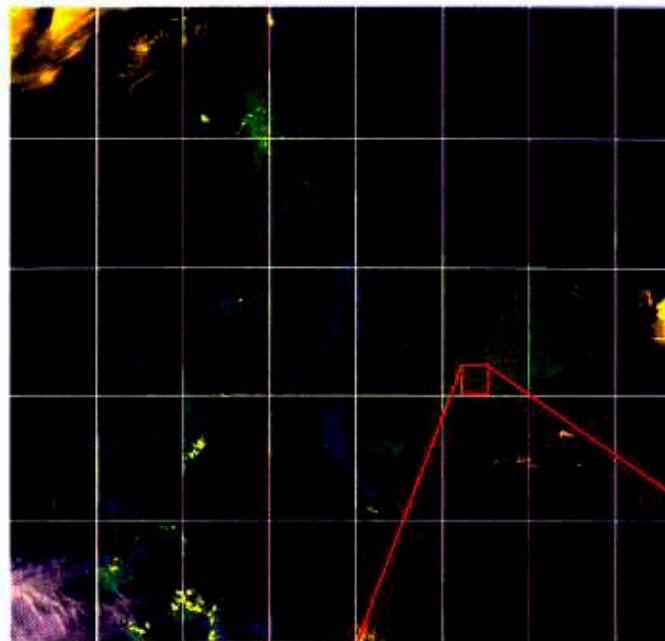


Fig. 12 Relationship between TP and chlorophyll a concentrations of euphotic waters of 34 Japanese lakes and 2 Chinese lakes.

Social and Environmental Systems Division



Koshiro Marsh

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

In FY 1995, the Division, with its Principal Researcher (PR) and its four research units, i.e., the Environmental Economics (EE), Resources Management (RM), Environmental Planning (EP) and Information Processing & Analysis (IP) Sections, conducted basic research on the following 12 topics:

Selected Basic Research Topics of S & ES Division

	Research Theme	in Charge of
(1)	Analysis of Some Fundamental Concepts in Environmental Management	(PR)
(2)	Treatment of Qualitative Information Concerning Environmental Problems	(PR)
(3)	Socio-economic Analysis and Policy Assessment for Environmental Management	(EE)
(4)	Potentially Effective International Collaboration for Global Environmental Protection	(EE)
(5)	Economic Impact of Environmental Policies	(EE)
(6)	Environmental Impacts Associated with Water Resources Development	(RM)
(7)	Recovery, Reuse and Recycling of Potential Resources for Waste Reduction and Their Impacts on Social and Environmental Systems	(RM)
(8)	Modelling and Policy Studies for Local and Regional Environmental Planning	(EP)
(9)	Information Processing Systems for Geographic and Image Data	(IP)
(10)	Modelling and Simulation Methodologies for Environmental Evaluation	(IP)
(11)	Environmental Evaluation Methodology Based on Psychological Responses	(EP)
(12)	Comparative Analysis of the Process of Policy-making in Selected European Countries for the Framework Convention on Climate Change Negotiations	(EE)

The first 2 research topics, which were conducted primarily by the Principal Researcher and associates, dealt with some selected basic issues concerning people's awareness and perceptions of the environment, which are fundamental to policy formulation for environmental conservation. Research topic (1) generated some interpretations of people's perceptions of the environment and their environmental protection actions, based on semantic recognition of nature. Research topic (2) is a basic methodology study for the development of effective environmental perception surveys. Using the results from a free association survey method, the quality of information obtained in the survey was analyzed to differentiate conceptual and sensuous descriptions of respondents.

Environmental
Economics Section

Several selected issues were studied under research topic (3): a questionnaire survey of consumers' life-styles and their perceptions of and attitudes/actions towards environmental conservation revealed that those who are active in the environmental protection movement are more likely to have life-styles which are environmentally benign. The possibility of reducing CO₂ emissions by changing the product selections of consumers was also investigated. A systematic international comparison of people's environmental awareness including value judgements and actions was performed with the results of a uniform questionnaire designed in several European countries and Japan. This study revealed that the awareness differences between groups with priority on the environment rather than on economy and the converse group is statistically significant in European countries, but not necessarily so in Japan. "Industrial Ecology" studies were also performed under this research topic to improve the effectiveness of internationally proposed instruments and methodologies for minimizing the environmental loading associated with industrial activity. Industrial efforts to enhance sustainability might be effectively implemented by reviewing corporate policy, processes and products. Thus this strategy is called the "3 P's Approach" to sustainable corporate practices. The instruments and methodologies of this approach include environmental auditing (EA), the environmental management system (EMS), environmental performance evaluation (EPE), life-cycle assessment (LCA) and environmental labelling (EL).

Research topic (4) deals with policy science analysis and assessment with a model of the development and implementation of an international environmental convention. The Framework Convention on Climate Change is the central international agreement that was studied in detail. The process of negotiations for the final agreement was analyzed in terms of the interests of participating nations. In addition, those who were directly involved in the process of policy-making for negotiations on the Framework Convention on Climate Change in three European countries (Germany, the Netherlands and the United Kingdom) were interviewed, under our research topic (12), to identify and investigate the factors that affected their decisions. The results were compared with those for the U.S.A. and Japan, which were obtained in the previous year.

The Second Generation Model (SGM), a computable general equilibrium model, which had been developed in FY 1994, was used to simulate the effects of a carbon tax and other economic instruments on the macro-economy as a major component of research topic (5). The model was also used to determine the best policy option to minimize the GDP loss by recycling the revenue to be obtained by taxation.

Resources
Management
Section

Under research topic (6), data were collected to build a model to evaluate the environmental as well as socio-economic impacts of a water resource development project. The Lake Kasumigaura watershed is the area studied, and data on water quality changes in both drinking water and agricultural irrigation systems were collected. Local residents' awareness of the impacts of eutrophication was also investigated.

Research topic (7) 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 topics of case studies, for which relevant data for inventory analysis were collected to improve our LCA method. An extended analysis of a refuse incinerator with power generation was also made for its entire life-cycle.

Environmental Planning Section

Improvement of local environmental plans is a central theme in research topic (8). Many regional and local authorities, prefectural as well as municipal, are now engaged in formulation of their local "basic" environment plans in conformity with the National Basic Environment Plan. Important but common issues arising from the planning process were carefully identified and analyzed in this study. Also, a questionnaire survey was performed on the information most needed by the local residents in Gumma Prefecture was conducted to promote public participation in the planning process at venues such as public hearings.

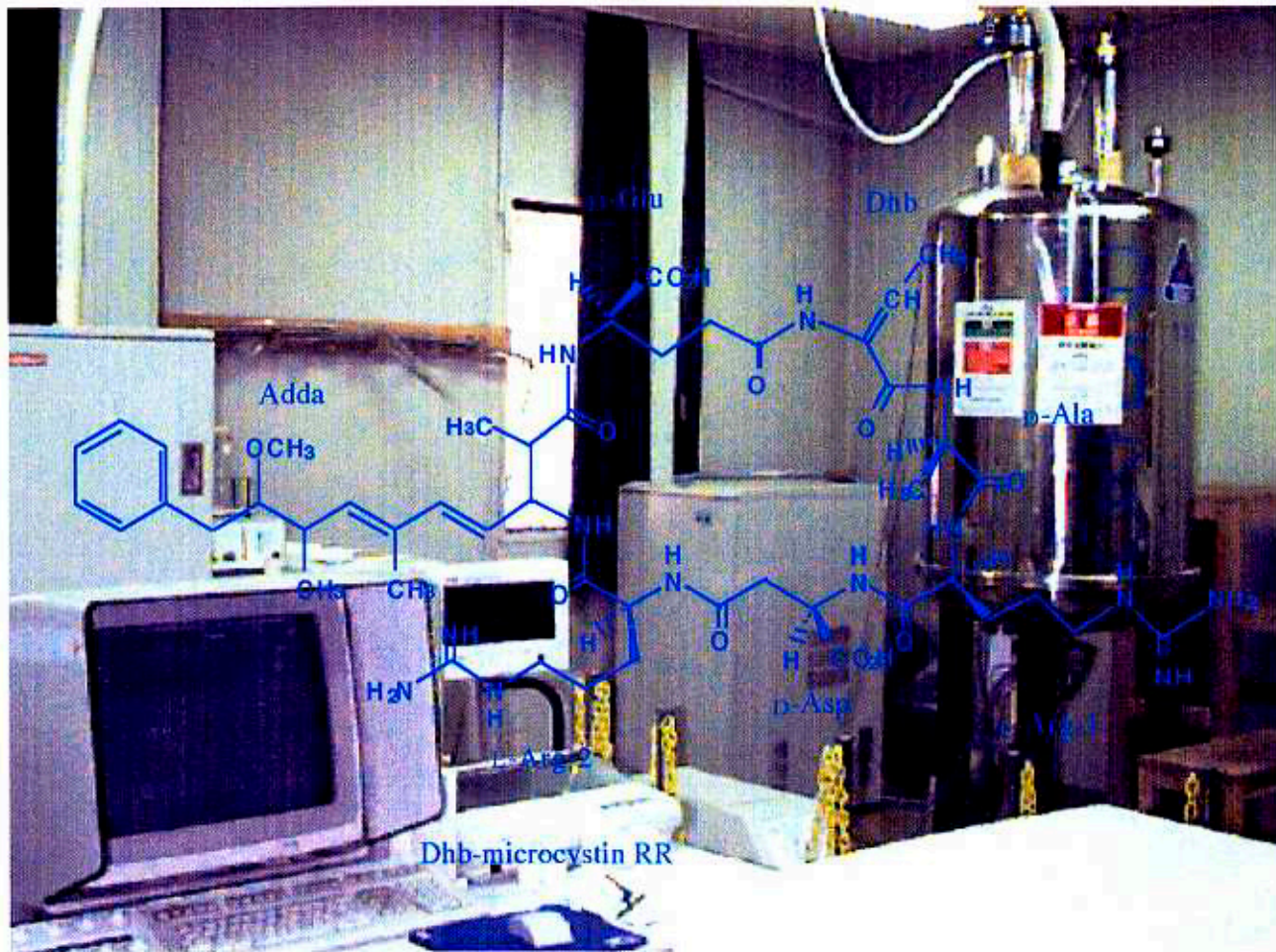
Under research topic (11), photographs that have been taken repeatedly at the same angles at selected points in Tsukuba Science City over the past decade were followed to evaluate the landscape vegetational changes. Certain kinds of trees have been identified important factors for evaluation of the landscape. 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 identified to determine landscape value.

Information Processing and Analysis Section

Developments under research topic (9) have produced improved image processing techniques for analysis of remotely sensed monitoring data such as the geographic and image data obtained from various earth observation satellites. Image data from the NOAA AVHRR have been obtained continuously from NIES's 2 NOAA Data Receiving Stations which were constructed in Kuroshima (Okinawa) and in Tsukuba in January and October of 1995, respectively. Data from these stations were used to develop a regional mosaic and vegetational index map for Eastern Asia. Techniques to monitor water quality and land cover distributions have been developed using other satellite data. Also techniques to merge satellite data and geographic information are being developed.

Research topic (10) concentrates on both development of models to analyze and quantitatively evaluate environmental changes, and simulations based on these models to predict changes. An elaborate traffic noise propagation model was developed and the noise field was simulated with the boundary element method under various environmental settings. Computational techniques that facilitate such simulations and visual presentation of the results were also developed.

Environmental Chemistry Division



A new toxin (Dhb-microcystin RR) structure and a nuclear magnetic resonance spectrometer.

Research in this division provides bases for analytical instrumentation, methodologies and quality assurance for environmental measurements. The division also conducts research on the fate and toxicology of chemicals. In FY 1995, 15 basic research projects concerning a wide range of environmental problems have been implemented. Members of the division also participated in eight research projects organized by the project research divisions, and 4 special projects which were subsidized by the Science and Technology Agency.

In the **Analytical Instrumentation and Methodology Section**, studies on analytical methods and instrumentation for environmental analysis, especially on methods using mass spectrometric systems, have continued. The distributions of selected volatile halocarbons over the ocean have been studied. A program to develop a system to detect DNA-toxic chemical adducts with high sensitivity has been conducted.

Studies on standardization and quality assurance in environmental analysis have continued in the **Analytical Quality Assurance Section**. The program to collect standard data and to construct a database for GC/MS identification of chemicals was completed this year. The analytical performance of plasma ion source mass spectrometry for stable isotope analysis was evaluated.

The **Environmental Chemodynamics Section** focuses on chemical state analysis, chemical speciation analysis, isotope analysis and their applications to the elucidation of the environmental fates of chemicals. The establishment and application of accelerator mass spectrometry techniques has been initiated (Fig. 1). The environmental fates and ecological effects of organotin compounds have been investigated.

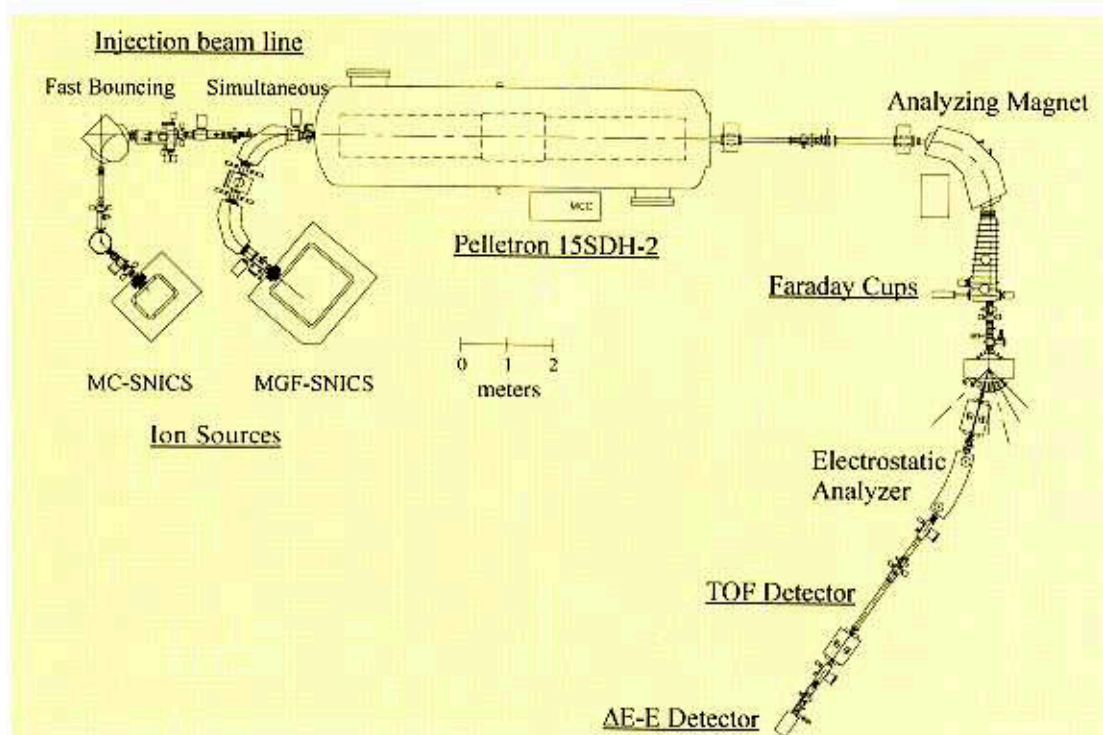


Fig. 1 Accelerator mass spectrometry Facility (NIES-TERRA).

In the **Chemical Toxicology Section**, studies on the chemical structures and toxicity of both natural and anthropogenic toxic compounds have continued. Toxins produced by blue-green algae and the mechanisms of their toxic action have been evaluated. A bioassay system which evaluates the effects of volatile halocarbons on cultured mammalian cells has been developed.

The environmental specimen banking program has been carried out for 16 years with special emphasis on monitoring of background pollution levels around Japan. Information on the monitoring data and the analytical data for specimens stored in the bank were exchanged with the U.S. National Oceanic and Atmospheric Administration (NOAA).

By the end of 1995, 16 CRMs had been prepared and 11 of them were certified for metal composition under the Environmental Certified Reference Material Program. In 1995, the concentrations of methylmercury and other metals in NIES CRM No.13, Human Hair, was finished and a toluene-extract of incinerator fly ash, NIES CRM No.17, was prepared as a new candidate CRM for dioxin and furan analysis.

Paleoenvironmental studies of Lake Baikal sediment cores began as an international joint project. This project constitutes an important program of the Baikal International Center for Ecological Research established under the initiative of the Russian Academy of Sciences.

Brief accounts of some of the important 1995 outcomes from the division are as follows:

Analysis of Neutral Products of MW excited C₂H₄ Plasma: Detection of C_n, C_nH₂, C_nH₃, C_nH₄, C_nH₅, etc.

Analysis of the products of a microwave (MW) discharge excited C₂H₄ plasma by lithium ion attachment mass spectrometry revealed many unexpected, neutral hydrocarbon products. The MW discharge conditions were adjusted to minimize the formation of charged species to confirm the presence of neutral compounds in the gas phase. Various free radicals and stable polymer molecules were detected. The radicals were of the forms such as C_nH₃ (n = 2 and 4) and C_nH₅ (n = 2 to 7), and the polymers were of the forms C_n (n = 3 to 5) and C_nH₂ (n = 2 to 9), species such as C₃H₂ and C₄H₂ are not widely known but have been observed in interstellar space. This work constitutes the first mass spectrometric detection of some of these species.

Development of a new library search system for GC/MS data

A new library system for searching GC/MS data on personal computers has been developed. This new system searches both known and unknown mass spectra, and interprets them. The search procedure for unknown spectra is divided into a pre-search and a main search. In the main search, three methods, the Biemann, PBM, and NIES methods, are used. A unique criterion, GC retention indices, can be used for library searches. The reliability of identification of unknown spectra was greatly

enhanced with these indices. The number of compounds containing specified elements in the database can be examined in dialogue mode. Identification of unknown spectra can sometimes be possible in this mode, even if a correct spectra does not exist in the database.

Analysis of stable isotopes by plasma ion source mass spectrometry

The performance of plasma ion source mass spectrometry in analysis of stable isotopes was evaluated. Several important applications of this method were found. Metals in environmental matrices were accurately and precisely determined with the stable isotope dilution technique. The environmental sources of lead in human bones could be identified. Isotope dilution/ICP/MS and /MIP/MS were extensively used in the certification of selenium, cadmium, mercury, and lead levels in CRMs and candidate reference materials from other sources.

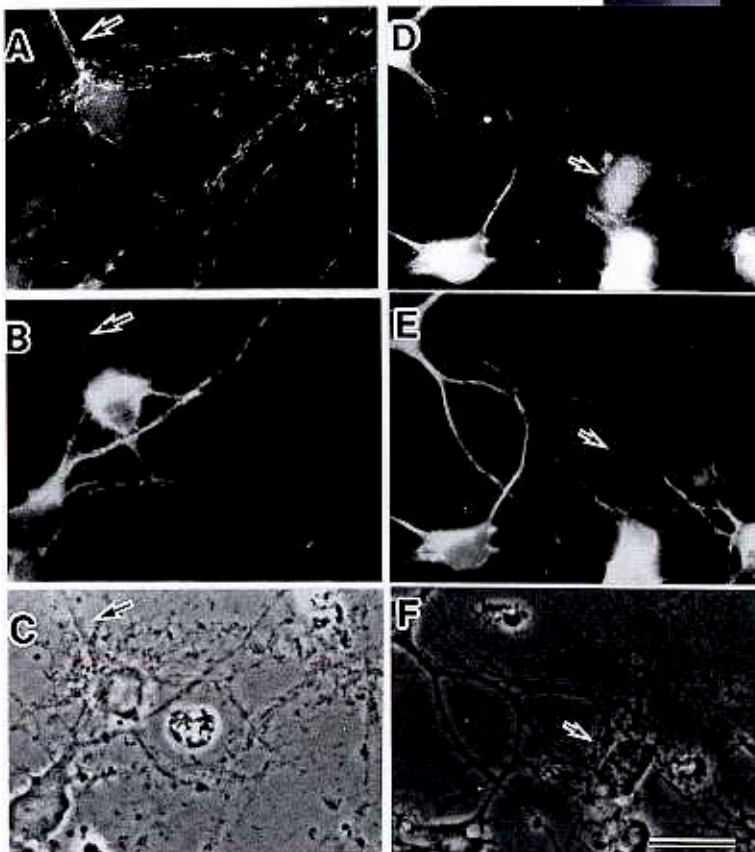
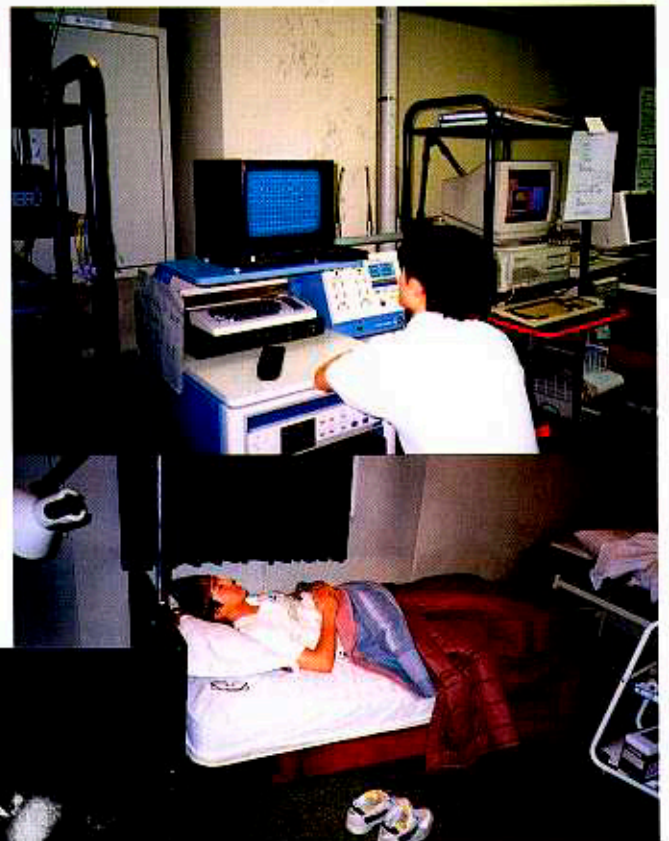
Effects of organotin compounds on gastropods: Imposex

'Imposex' is a superimposition of male sex organs, such as the penis, on female gastropods (not all gastropods are marine snails) which may cause reproductive failure. 'Imposex' is caused by exposure to organotin compounds, such as TBT and TPT. As of June 1995, 38 species of Japanese gastropods have been confirmed to be affected by 'imposex'. Histological examination of the reproductive failure of an Archeogastropod, abalone, has been carried out. Organotin concentrations in abalone tissue have been determined by gas chromatography with flame photometric detection. The LC₅₀ values of organotin compounds to the veliger larvae of disk abalone (*Haliotis discus discus*) were evaluated with 48 hour-acute toxicity tests.

Chemical structures and biological activities of algicidal compounds

The general structure of the microcystins, which are produced by some strains of *Oscillatoria agardii*, is cyclo (-D-Ala-X-D- MeAsp-Z-Adda-D-Glu-Mdha-), where X and Z are variable L-amino acids, D-MeAsp is D-erythro-β-methylaspartic acid, Mdha is N-methyldehydro- alanine, and Adda is (2S,3S,8S,9S)-3-amino-9-methoxy-2,6,8-trimethyl-10-phenyldeca-4,6-dienoic acid (See Panel on page 37). The two acidic amino acids, D-MeAsp and D-Glu, are connected by an isolinkage. We identified the chemical structure of a novel microcystin of the cyanobacterium *Oscillatoria agardii* NIES-610 which contains a 2-amino-2-butenic acid (dehydrobutyryne, Dhb). The toxin is expressed as [D-Asp³, Dhb⁷]microcystin RR (Dhb-microcystin RR). The retention time of Dhb-microcystin RR in HPLC analysis, and its UV absorption spectra and intensities were the same as those of [Asp³]microcystin RR (desmethylmicrocystin RR). Furthermore, the molecular formula of Dhb-microcystin RR agreed well with that of desmethylmicrocystin RR. However, the ¹H-NMR spectrum of Dhb-microcystin RR was clearly different from that of desmethylmicrocystin RR.

Environmental Health Sciences Division



Immunocytochemical localization of 440 kD and 220 kD ankyrin_β in primary cerebellar cells of rats. Cerebellar cells cultured for 12 days were stained with double-label immunofluorescence using antibody 1 (A) or antibody 3 (D), and anti-MAP2 (B, E) simultaneously. Corresponding phase contrast micrographs (C, F) are also shown. Scale Bar, 20 μ m.

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 manifestations of health effects as well as the development of detection and assessment methodologies 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 as either domestic or global environmental issues. During fiscal 1995 we performed 15 Regular Research and 3 Special Encouragement Research programs. Experimental studies were performed in three sections: the Biochemistry and Physiology, Experimental Pathology and Toxicology, and Biological and Health Indicators Sections. In addition, studies that dealt with human populations were carried out in the Environmental Epidemiology Section. Research objectives which were considered to be both domestic and global environmental issues have also been pursued as research projects or programs supported by the Global Environment Research Program or the Special Research Program, in collaboration with scientists belonging to the Global Environment and Regional Environment Divisions.

In this year's report we describe, in greater detail, results of a study of a neuron-specific isoform of brain ankyrin, 440 kD ankyrin_B, which can be a useful tool in neurobiology and neurotoxicology.

Ankyrins are a family of spectrin-binding proteins that link the spectrin/actin network to cytoplasmic domains of integral membrane proteins which include ion channels and cell adhesion molecules. Three different ankyrins are currently known to be expressed in brain tissue: ankyrin_R, which is also expressed in erythrocytes; ankyrin_B, the major ankyrin in the brain; and ankyrin_C, which is localized to axonal initial segments and the nodes of Ranvier of myelinated axons. Ankyrin_B includes two isoforms of 220 kD and 440 kD which are generated from a single gene by alternative splicing of pre-mRNA (Otto, E., Kunimoto, M., McLaughlin, T., and Bennett, V. (1991) *J. Cell Biol.* 114, 241-253). In adult rat brain 220 kD ankyrin_B is the major ankyrin isoform, while 440 kD ankyrin_B, in contrast, is maximally expressed in developing neonatal rat brain (Kunimoto, M., Otto, E., and Bennett, V. (1991) *J. Cell Biol.* 115, 1319-1331). Immunocytochemical staining of developing rat cerebellum and optic nerve implies that 440 kD ankyrin_B is localized to unmyelinated and premyelinated axons.

We have also shown that 440 kD ankyrin_B is up-regulated concomitantly with neurite outgrowth in human neuroblastoma NB-1 cells, whose neurite extension can be promoted by external stimuli such as exposure to dibutyryl cAMP (Kunimoto, M. (1995) *FEBS Lett.* 357, 217-220). Thus 440 kD ankyrin_B can be regarded as a neuronal growth-associated protein like GAP (growth-associated protein)-43.

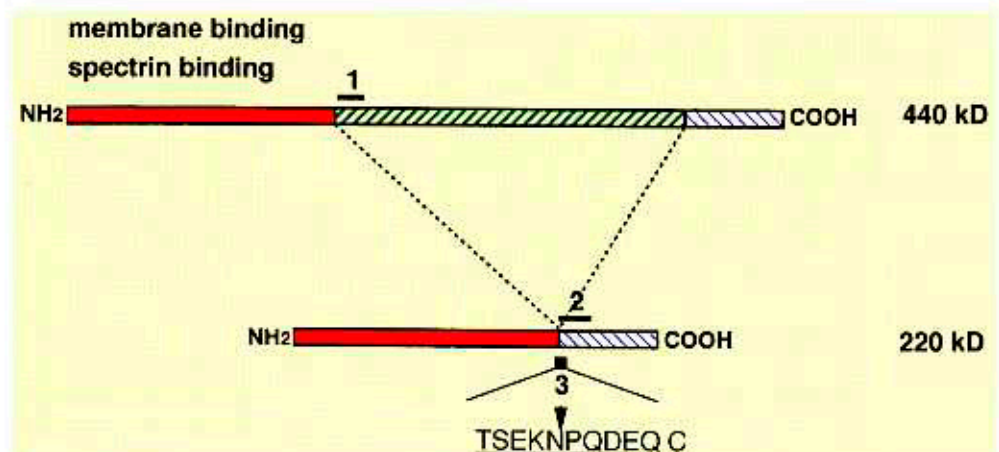
Taken together, these results strongly suggest that 440 kD ankyrin_B has potential to be a useful tool in neurobiology and neurotoxicology. Two recent studies which used this protein to investigate neuronal development and neuronal degeneration are described below.

A neuron-specific isoform of brain ankyrin, 440 kD ankyrin_B, is targeted to the axons of rat cerebellar neurons (Kunimoto, M. (1995) *J. Cell Biol.* 131, 1821-1829)

As mentioned above, 440 kD ankyrin_B has been localized to unmyelinated and premyelinated axons. Localization of 220 kD ankyrin_B, however, had not previously been clearly demonstrated, because this isoform is totally subsumed within the 440 kD isoform (Fig. 1), which prevents the production of specific antibodies by standard strategies using recombinant proteins as antigens. Therefore, a synthetic peptide corresponding to the splice site (ten amino acids, TSEKNPQDEQ, corresponding to the splice site plus an artificial C at the carboxy terminus for coupling to bovine serum albumin, Fig. 1, Region 3) was designed to prepare a polyclonal antibody which can recognize the 220 kD isoform specifically. Such an antibody (antibody 3), raised against the synthetic peptide specifically recognizes 220 kD ankyrin_B in Western blot analysis of rat cerebellum. An antibody against Region 1 in Fig. 1 (antibody 1) recognizes 440 kD ankyrin_B specifically and an antibody against Region 2 (antibody 2) recognizes both the 440 kD and 220 kD isoforms. The expression and localization of the two ankyrin_B isoforms in cerebellar cells was investigated with these antibodies.

In primary cerebellar cells stained by double-label immunofluorescence, 440 kD ankyrin_B is localized to the axons (see Panel A on page 41, indicated by an arrow), while MAP2 (microtubule associated protein 2, a neuronal marker) is localized to the dendrites and cell bodies of neurons (see Panel B on page 41). Conversely, the staining of 220 kD ankyrin_B is quite similar to that of MAP2 (see Panels D and E on page 41). In addition, 220 kD ankyrin_B is localized to astroglial cells which are not stained by anti-MAP2 antibody (see Panels D and E on page 41, small arrows), but are stained by anti-GFAP (glial fibrillary acidic protein, an astroglial marker) antibody (data not shown). This is the first example of alternative splicing in neurons which produces protein isoforms differentially targeted to axons and dendrites/cell bodies.

Fig. 1
Schematic organization of ankyrin_B isoforms. Recombinant proteins corresponding to regions 1 and 2 were used as antigens to prepare polyclonal antibodies 1 and 2, respectively. A synthetic peptide corresponding to region 3 was used to prepare antibody 3.



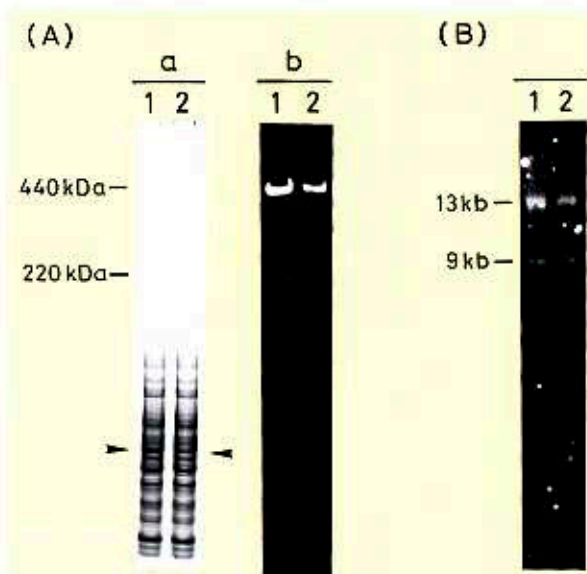
These results clearly indicate that 440 kD ankyrin_B is a neuron-specific isoform, while 220 kD ankyrin_B is expressed both in neurons and glial cells. In addition, 440 kD ankyrin_B is sorted to the axons, while the 220 kD isoform, which can be regarded as a naturally-occurring deletion mutant of 440 kD ankyrin_B lacking the 220 kD inserted domain, remains in both the dendrites and cell bodies of neuronal cells, even though both ankyrin_B isoforms share the same membrane binding domain (see Fig. 1). Taken together, these data suggest that the 220 kD inserted domain is essential for the sorting of 440 kD ankyrin_B to the axons. It is also conceivable that the differential sorting mechanism, but not the membrane binding domain itself, may be responsible for determining the target sites of each ankyrin isoform, cytoplasmic domains of integral membrane proteins. To date, only a few proteins, such as tau and GAP-43, have been shown to be targeted to growth cones and/or axons, and the sorting mechanism has not been elucidated. Ankyrin_G is targeted to nodes of Ranvier and to the initial segments of axons. Although this ankyrin isoform has not yet been cloned or sequenced, it too may have a unique insert which is responsible for the targeting. Ankyrins may well be a useful model for investigating protein sorting in neurons.

Selective down-regulation of 440 kD ankyrin_B associated with neurite retraction induced by methylmercury (Kunimoto, M., and Suzuki, T. (1995) *NeuroReport* 6, 2545-2548)

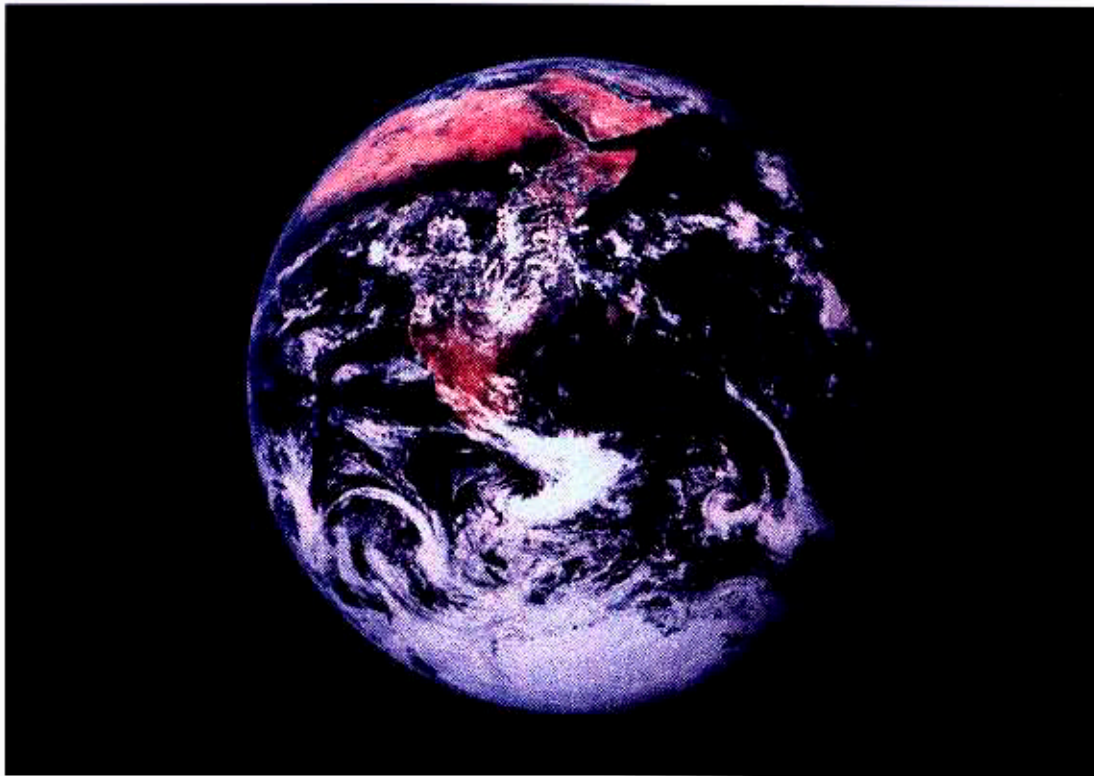
Human neuroblastoma NB-1 cells express both 440 kD and 220 kD ankyrin_B and the expression of the larger isoform is increased upon induction of neurite outgrowth. An exposure to methylmercury, a potent neurotoxic substance, at a sublethal dose induced dramatic retraction of neurites in NB-1 cells. Concomitantly, polypeptide and mRNA (13 kb) of 440 kD ankyrin_B were selectively attenuated in the methylmercury-treated cells, while those of the 220 kD isoform were not affected (Fig. 2). These results indicate that the expression of 440 kD ankyrin_B in neuronal cells is intimately associated not only with neurite outgrowth, but also with neurite retraction, and that it is regulated at the mRNA level.

Fig 2.

Methylmercury-induced down-regulation of 440 kD ankyrin_B in NB-1 cells. (A) Total proteins of NB-1 cells treated with 1 μ M methylmercury (lane 2) and untreated controls (lane 1) were separated by electrophoresis on SDS-polyacrylamide gel, transferred to Immobilon-P membranes and immunoblotted using antibody 2, which recognizes both the 440 kD and 220 kD isoforms (b). Coomassie brilliant blue stained gels run in parallel to those blotted are also shown (a) and the position of tubulin is indicated by arrowheads. (B) Total RNA isolated from NB-1 cells treated with 1 μ M methylmercury (lane 2) and untreated controls (lane 1) were separated on formaldehyde/1.2% agarose gel and transferred to nitrocellulose membranes. The blot was hybridized with a ³²P-labeled cDNA probe which can detect both 13 kb and 9 kb mRNA bands.



Atmospheric Environment Division



The Atmospheric Environment Division conducts basic research 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 operated 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, the results of which facilitate study of both global (global warming, stratospheric ozone, acid rain, etc.) and regional scale environmental issues. A high-accuracy and high-efficiency general circulation model (GCM) developed through joint research with the University of Tokyo is used intensively. Improvements to and validations of this GCM focused, especially, on stratospheric dynamics, gravity wave propagation and land surface parametrization are in progress. The interaction processes between tropical cumulus activity and large-scale atmospheric dynamics were also studied by analyzing meteorological satellite data and numerical studies with the GCM. Models of land surface processes and meso-scale atmospheric transport/diffusion processes were studied based on the GCM (Fig. 1).

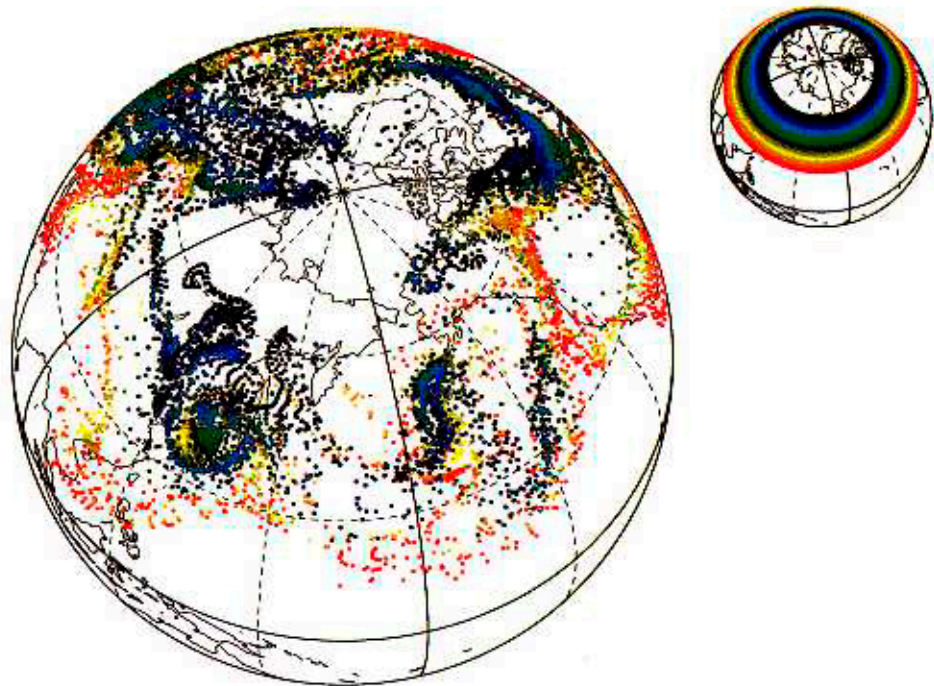


Fig. 1

Calculation of tracer trajectories with a wind field generated by an atmospheric general circulation model. The locations of particles two days after the given initial distribution (small upper diagram).

Chemical Reaction Section

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

Temperature Dependence of Rates of Reactions between Free Radicals and Atomic Oxygen or Nitrogen. Rate constants for reactions of $\text{HS} + \text{O}(^3\text{P})$, $\text{NH}_2 + \text{O}(^3\text{P})$, $\text{NH}_2 + \text{N}(^4\text{S})$, $\text{CH}_3 + \text{N}(^4\text{S})$, $\text{HNO} + \text{O}(^3\text{P})$, and $\text{H}_2\text{CN} + \text{N}(^4\text{S})$ were measured with a photoionization mass spectrometer coupled with the combination of discharge flow and pulsed laser photolysis. No temperature dependence was observed in any of the reactions. Rate constants for reactions of HS, NH_2 , and CH_3 with $\text{O}(^3\text{P})$ and $\text{N}(^4\text{S})$ atoms were very rapid, $1\text{--}2 \times 10^{-10} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$. The corresponding rate constants for $\text{HNO} + \text{O}$, $\text{H}_2\text{CN} + \text{N}$ were about $5 \times 10^{-11} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$. The lack of temperature dependence of the rates for $\text{CH}_3 + \text{N}$ and $\text{H}_2\text{CN} + \text{N}$ contradicted previous reports.

Laser Induced Fluorescence of the $\text{C}_2\text{H}_2\text{FO}$ Radical Produced in Reactions of Fluoroethylenes with Atomic Oxygen. A new, laser induced fluorescence spectrum was observed in reactions of $\text{C}_2\text{H}_3\text{F} + \text{O}$ and $\text{C}_2\text{H}_2\text{F}_2 + \text{O}$. Since the spectrum obtained was similar to that of vinyoxy radical ($\text{C}_2\text{H}_3\text{O}$), which was reported previously, it seems supposed that the $\text{C}_2\text{H}_2\text{FO}$ spectrum was observed. Spectrum analysis continues.

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 observations of stratospheric and tropospheric aerosols

Aerosols in the troposphere and stratosphere have been observed with the NIES large Nd:YAG lidar and a compact lidar (Fig. 2). Lidar methods for quantitative measurement of optical parameters and size distribution of aerosols are being studied.

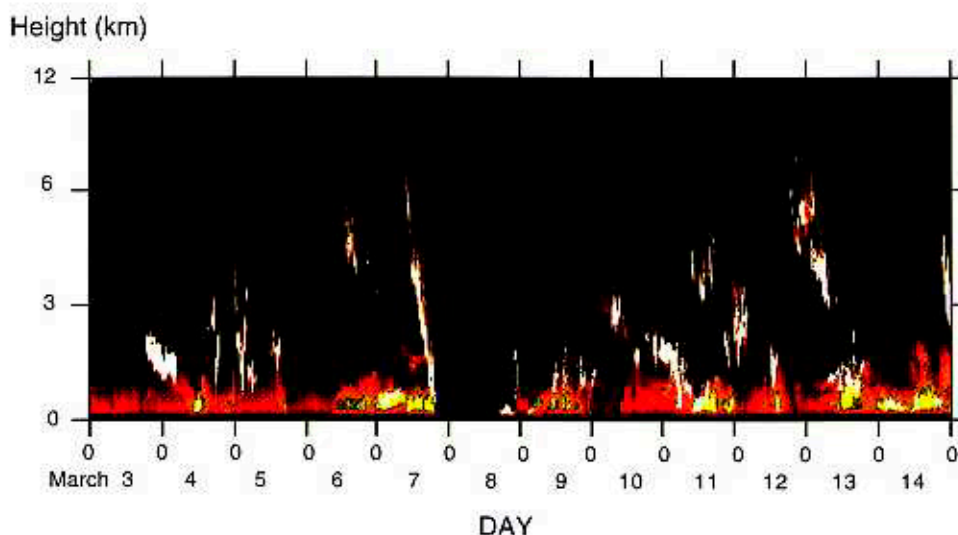


Fig. 2
Variations in the vertical profile of tropospheric aerosols measured with a compact lidar over 12 days. The structures of aerosol distribution and clouds which are related to the structures of warm fronts are apparent.

Retroreflector in Space (RIS)

Preparations for earth-satellite-earth laser long-path absorption measurements of atmospheric trace species using the Retroreflector in Space (RIS) for the Advanced Earth Observing Satellite (ADEOS) are underway. A CO₂ laser transmitter/receiver system for the RIS experiment has been constructed at the satellite tracking facility at the Communications Research Laboratory. Final adjustments of the system are being made. Measurements of vertical profiles of O₃ and CH₄, and column contents of CFC₁₂, HNO₃, CO, N₂O, etc. will be carried after launch of the ADEOS in August, 1996. A study on remote sensors for future satellite programs is also being conducted.

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. Measurements of greenhouse gas and related species from ground base stations and aircraft have contributed to these efforts. One activity has been airborne measurements of atmospheric CH₄ over oil fields and natural wetlands in West Siberia (Fig. 3). The airborne measurements of atmospheric CH₄ distribution have been performed on a gas chromatograph and a combustion/flame ionization detector (GC/FID) system. The latter is used to detect CH₄ continuously by FID after selective combustion of non-methane hydrocarbons during passage of air samples through a heated catalyst column. On August 1, 1994, extremely sharp peaks in the horizontal distribution of CH₄ at an altitude of 150 m above the ground surface were observed. The half width of these peaks were 3-4 km and the concentration corresponding to the largest peak was greater than 2.9 ppmv. Since the CH₄ distribution was considered to reflect the distribution of CH₄ emission strength on the surface, a strong CH₄ emission source near the position where those peaks were detected must exist. There are oil production sites and/or an oil pipeline near the locations above which all of the observed CH₄ peaks were detected, suggesting that natural gas was emitted from those facilities. Leakage or venting of the natural gas are probable CH₄ sources.

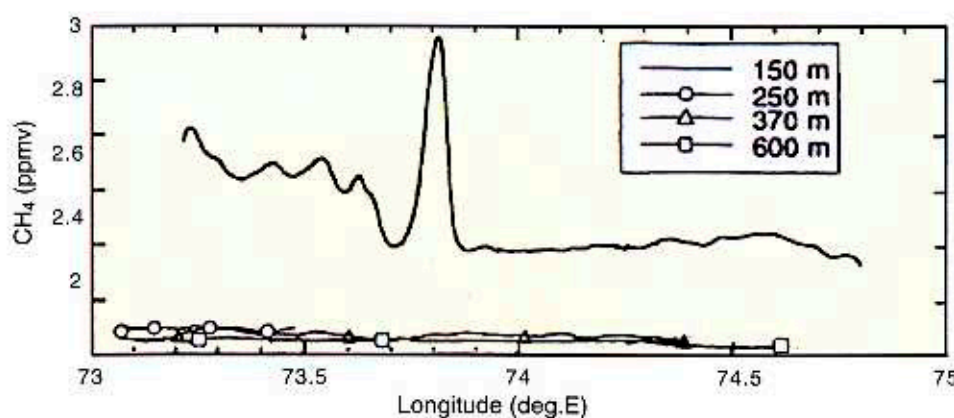
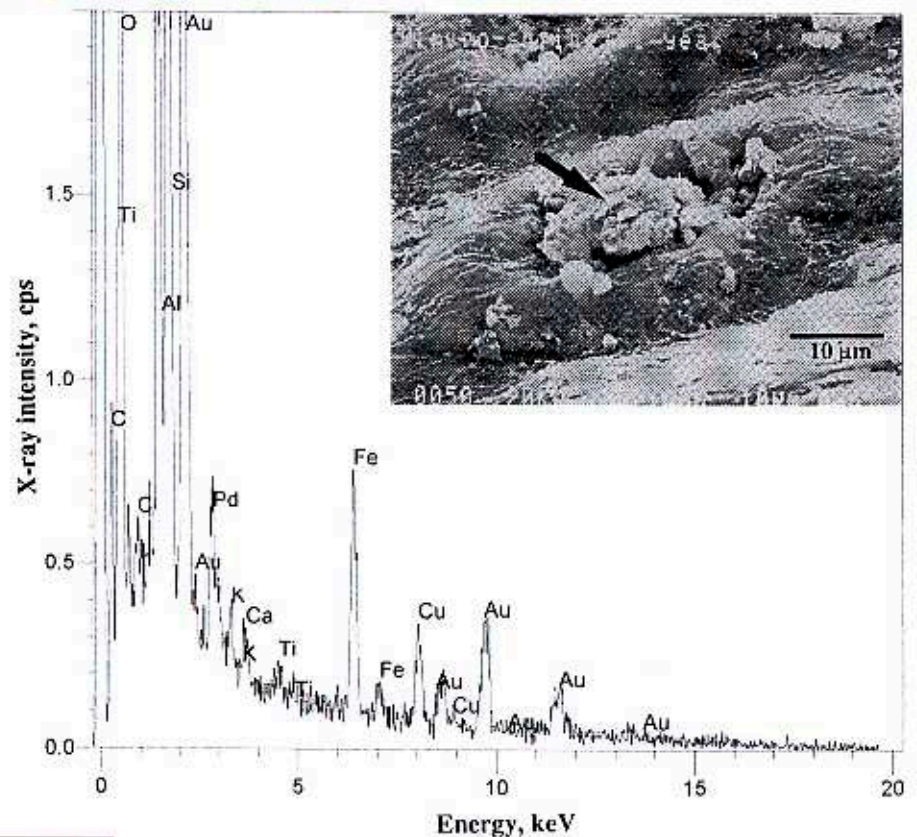


Fig. 3 Distribution of CH₄ observed over oil field to the north of Surgut in the western Siberia.

Water and Soil Environment Division



SEM micrograph and EDX spectrum of aerosols deposited in a stoma of Japanese cedar (*Cryptomeria japonica*) from Saitama Pref.



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 freshwater 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

An engineering approach to conservation of natural environments and ecosystems in lakes, rivers, and oceans is taken by the Water Environment Engineering Section. The studies listed below are the main foci of the Water Environment Engineering Section's research.

1. The relationship between paddy field pesticide runoff processes and pesticide adsorption and degradation (Fig. 1)
2. Humic substances in the aquatic environment
3. Hydrological studies of the global environment with remote sensing data and a geographic information system
4. Mechanisms leading to red tides in a stratified ocean environment

Water Quality Science Section

The fate and cleanup of pollutants in aquatic environments

Groundwater and soil contamination with chlorinated aliphatic compounds such as tetrachloroethylene (PCE), trichloroethylene (TCE) and 1,1,1-trichloroethane (TCA) has been detected in many places. Bioremediation technology has been developed using microorganisms to clean up contaminated soil and groundwater. A methane-utilizing TCE degrading bacterium, *Methylocystis* sp. strain M (hereafter termed strain

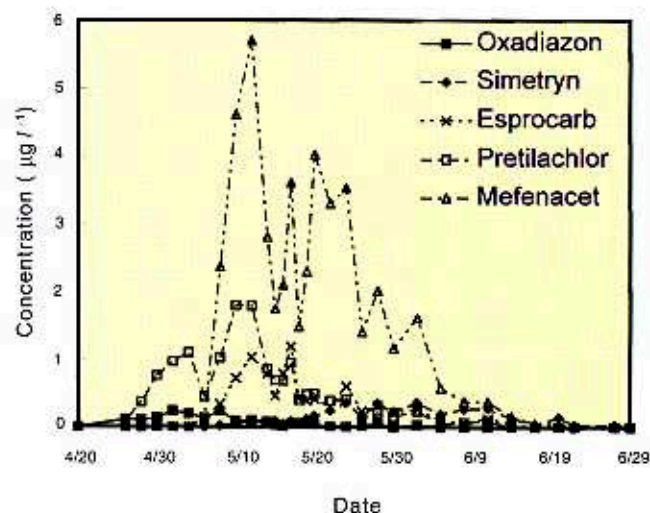
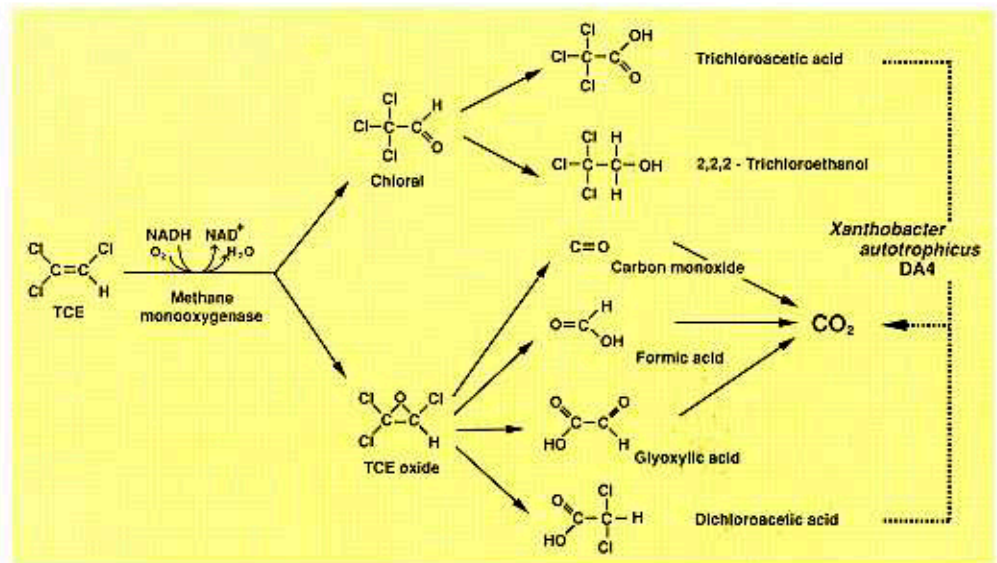


Fig. 1 Change in concentration of dissolved herbicides in the Koise River.

Fig. 2
A hypothetical pathway of TCE degradation by strain M showing the role of strain DA4, as well.



M), was isolated from soil. However, during TCE degradation by strain M, inactivation occurs with a relatively short half-life. Therefore, a stable TCE degrading culture system was sought. The TCE degrading activity of alginate-immobilized strain M was compared with that of a mixed culture of strain M and a haloacetate degrading bacterium, *Xanthobacter autotrophicus* DA4 (hereafter termed strain DA4). In a liquid-solid phase reaction system, no significant difference in the degradation rate between the strain M culture and the mixed culture was observed. In contrast, in a gas-solid phase reaction system, the mixed culture exhibited higher degradation rates than were observed in the pure culture. These results suggested that the enhancement effect may derive from metabolic activity of strain DA4. Under semi-continuous reaction conditions, the mixed culture showed more prolonged degradation activity (Fig. 2).

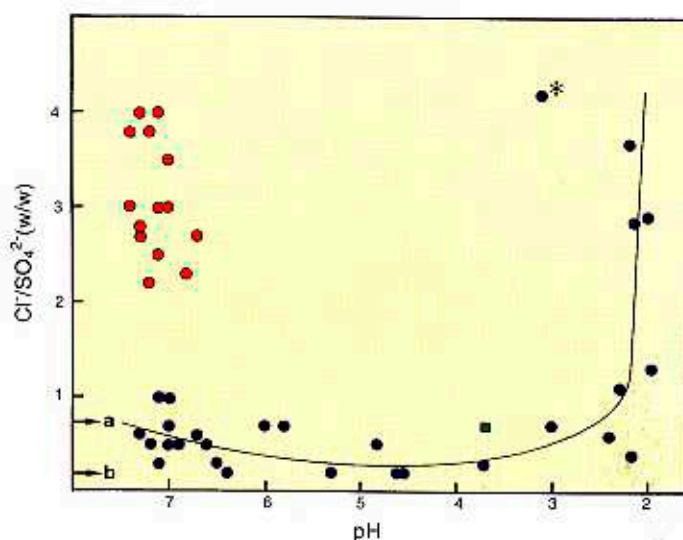
Both TCA and TCE degrading bacteria, strains TA5 and TA27, respectively, were isolated and identified as *Mycobacterium* sp. Both strains cannot utilize TCA and TCE as their sole carbon source, but can co-metabolize TCA and TCE with ethane and ethanol. Both strains can degrade TCA and TCE at concentrations greater than 50 and 30 ppm, respectively, under aerobic conditions.

Soil Science Section

Limnological and sedimentological studies of Lake Usori-ko and its watershed

We studied the quality of water and sediment as well as the aquatic flora in Lake Usori, a typical volcanic acid lake located on the Shimokita Peninsula, Japan, and in its watershed. The lake water was acidic (pH: ca. 3.8) and contained sulfate (ca. 0.8 meq l⁻¹) and chloride (ca. 0.7 meq l⁻¹) as the major anions (Total anions: 1.557 meq l⁻¹). This concentration of anions was approximately equivalent to the total concentration (1.560 meq l⁻¹) of Na, K, Mg, Ca, Al and Fe. At the lake's deepest point (ca. 16 m) located in the northern part of the lake, water stratified in summer and unusual sulfur cycling was observed just below the thermocline, with the production of colloidal sulfur. The water pH and Cl⁻/SO₄²⁻ weight ratio of influent

Fig. 3
Relationship between pH and the $\text{Cl}^-/\text{SO}_4^{2-}$ ratio in river water flowing into Lake Usoriko. (●) and (●): rivers in the eastern and the other parts of the basin, respectively. *: affected by domestic wastewater. ■: surface water at the central part of the lake. a: mean $\text{Cl}^-/\text{SO}_4^{2-}$ ratio in the Japanese rivers. b: $\text{Cl}^-/\text{SO}_4^{2-}$ ratio in the earth's crust.



rivers varied from 1.9 to 7.4 and from 0.2 to 4.0, respectively, depending on the inflow of hot spring water (Fig. 3). Concentrations of elements other than heavy metals and some non-easily weathered elements, such as Ti, were generally low in the lake sediment. However, the water was extremely rich in arsenic (0.45 - 2.60 %), a part of which occurred in organic forms including *monomethylarsenate* and *dimethylarsinate* (ca. 0.1 % of acid-extractable As). Among the aquatic flora, [*Drepanocladus fluitans* (Hedw.) Warnst.], may have a significant role in the cycling of elements within this lake because of its characteristic distribution as a thick mat on the lake sediment surface and extremely large biomass.

Geotechnical Engineering Section

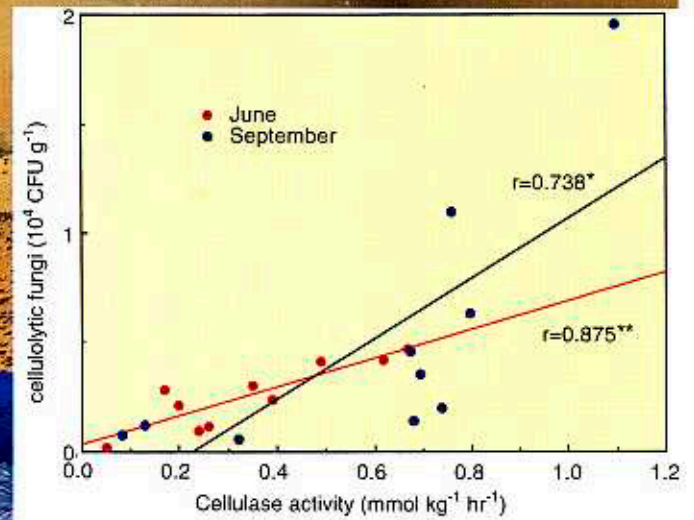
Land subsidence in Niigata Prefecture

Areas along the Japan Sea experience heavy snowfall during winter. The maximum depth of snow in most areas of the coastal plain is more than 3 m. In order to avoid disruption of the daily lives of residents during the winter season, various methods of clearing snow have been adopted. In 1968, a new method to melt snow which is rapidly becoming popular was implemented in Nagaoka City. The snow is melted by sprinkling it with groundwater from pipes set up along roads and parking lots, etc.

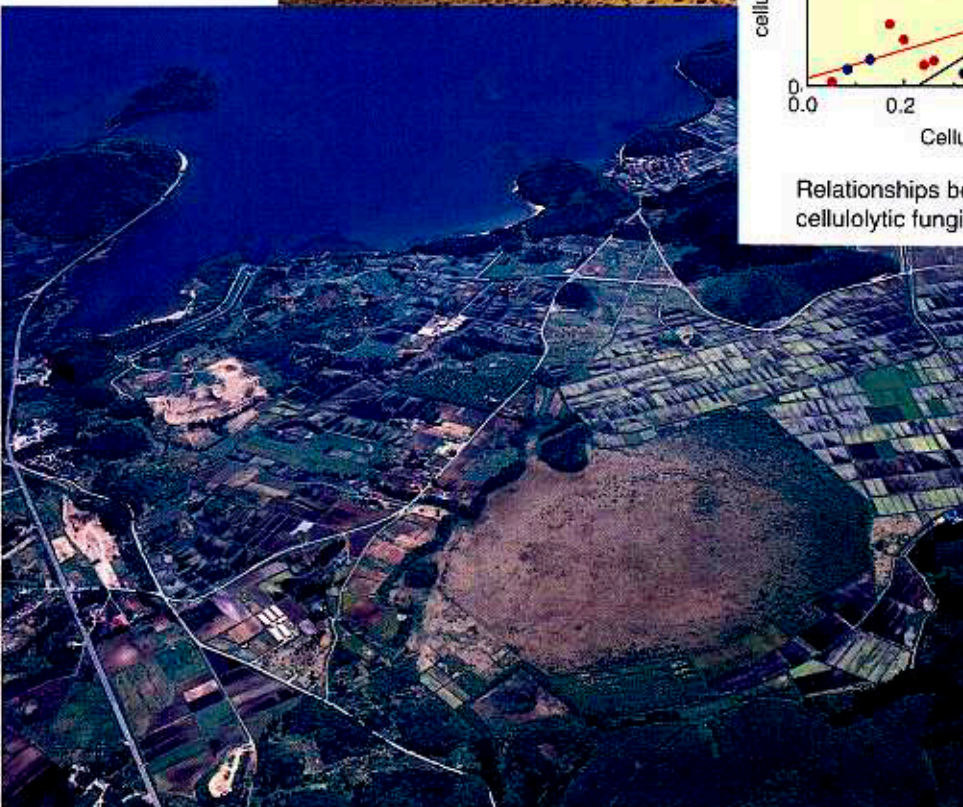
In Jo-etsu City and Muikamachi Town, which are among the areas with the heaviest snowfall in Japan, the groundwater levels are rapidly lowered in winter by about 7 m and the ground surface subsides about 3 cm each year. Serious land subsidence is thus caused by repeated loading due to the changes in groundwater levels.

In Muikamachi Town, the upper clay layer is very soft, having an N-value of nearly zero as observed from standard penetration tests. This layer is of Holocene age, extending from the ground surface to a depth of about 10 m. The next clay layer, with humus, is of latest Pleistocene age extending from about 18 to 28 m depth. Both layers were found to be somewhat overconsolidated by past repeated loading.

Environmental Biology Division



Relationships between cellulase activity and number of cellulolytic fungi.



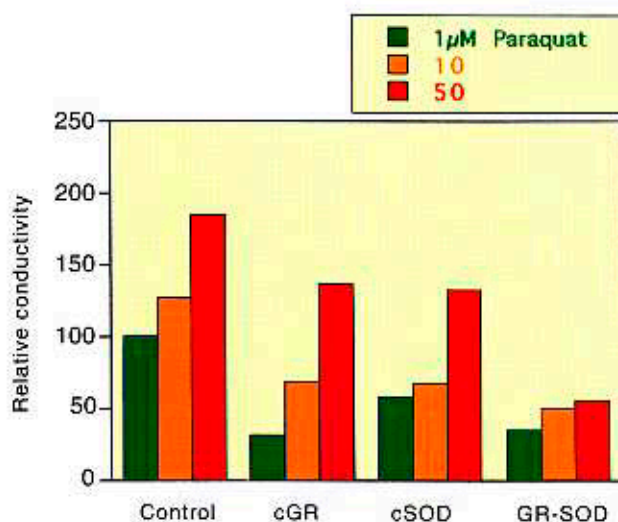
The Environmental Biology Division consists of four sections: the Molecular Biology, Environmental Microbiology, Environmental Plant Science and Ecosystem Study Sections. The division performs basic and applied research on the effects of various environmental stresses, both chemical and physical, on 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 ecosystems. In 1995 we performed 18 studies funded by NIES and two studies funded by the Science and Technology Agency. In addition, the division conducted a special research project for the conservation of wetland ecosystems, the results of which are presented in the Regional Environmental Research Division chapter.

The **Molecular Biology Section** worked on 1) analysis of the mechanism of plant tolerance to various environmental stresses and 2) cloning and structural analysis of genes encoding enzymes responsible for such stress tolerance.

Two of the enzymes of an active oxygen scavenging system, glutathione reductase (GR) and superoxide dismutase (SOD), are postulated to play important roles in plant tolerance to photooxidative stress caused by air pollutants and some kind of herbicides in the light. Previous studies by this section showed that transgenic tobacco with the *Escherichia coli* GR gene has higher tolerance to an air pollutant, sulfur dioxide, and a superoxide radical ($O_2^{\cdot-}$)-generating herbicide, paraquat, than did control plants. It has also been reported that SOD activity positively correlates with paraquat tolerances.

Transgenic tobacco plants (*Nicotiana tabacum* L. cv SR1) with enhanced cytosolic activities of GR and SOD (GR-SOD) were generated by cross-fertilization of two types of transgenic plants (cGR and cSOD), resulting in increased activity of GR or SOD. Leaves of the hybrids exhibited much greater tolerance to paraquat than did their parents (Fig. 1). This result indicates that GR and SOD work together to protect plants against photooxidative stress and that manipulating more than one gene may effectively improve resistance of plants to such stress.

Fig. 1
Electrolyte leakage from paraquat-treated leaf discs. Electrolyte leakage reflects membrane destruction of cells caused by paraquat treatment. Changes in conductivity of transgenic and nontransgenic (control) SR1 plants over the 5 hours following the start of paraquat exposure, plotted relative to the change in conductivity of control plants exposed to 1 μ M paraquat. The mean values \pm SE obtained from 3 experiments are shown.



In the **Environmental Microbiology Section**, studies have been carried out on 1) the diversity of microorganisms, 2) the distribution and culture of charophytes that are in urgent need of protection, 3) the enzymology of soil organic matter decomposition and 4) the fate of algal toxins in a eutrophic lake.

Cellulase activity of peat soil in a mire in Fukushima prefecture was measured. The cellulase activities in September were higher than those in June. Cellulase activity was significantly and positively correlated with the viable count of cellulolytic fungi (see panel on page 53) but not with that of cellulolytic bacteria. A significant positive correlation was also found between the viable count of bacteria and the concentration of reducing sugars. These results suggest that cellulase in this ecosystem is produced mainly by cellulolytic fungi, and that bacteria grow by degrading the reducing sugar produced by cellulose decomposition. From the peat soil we isolated 7 strains of filamentous cellulolytic fungi, belonging to the genera *Penicillium* and *Trichoderma*. An enzyme capable of degrading cellulose was extracted in a crude state from cultures of these microorganisms.

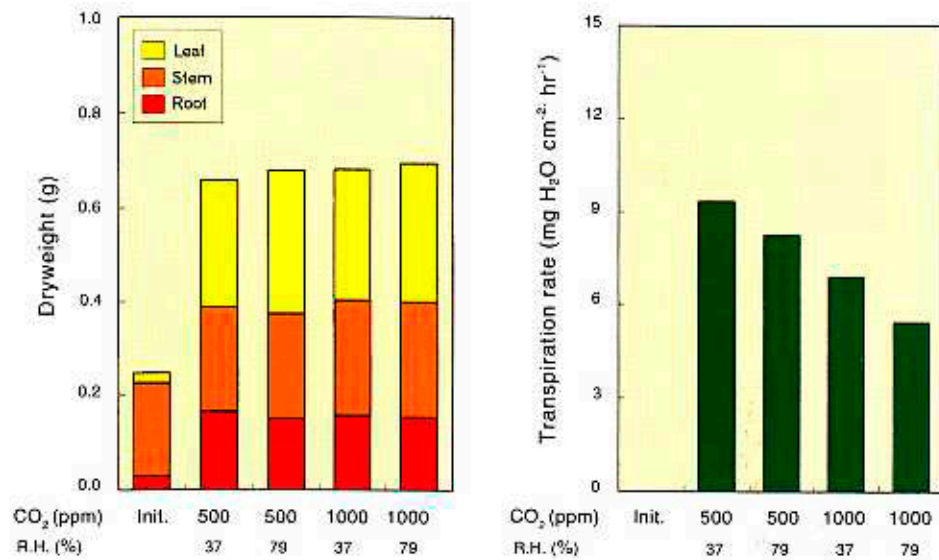
In the **Environmental Plant Science Section**, studies have been carried out on 1) the effects of desertification and global warming on plants and vegetation and 2) the development of new instrumentation techniques for diagnosing such effects.

In order to estimate the effects of global warming on plants, changes in the growth and transpiration of several crops (C_3 and C_4 plants) to changes in carbon dioxide (CO_2) concentration, air temperature and/or relative humidity were investigated in artificially-lighted growth cabinets. The dry weight growth and leaf area growth were accelerated by an increase in CO_2 concentration and reduced by an increase in air temperature or by a decrease in humidity, though the extents of these trends varied with species. These environmental factors modified some growth parameters such as relative growth rate, net assimilation rate and leaf area ratio in many plant species. An increase in CO_2 concentration decreased the transpiration rate of several plants, especially corn, to maintain the water use efficiency at a high level (Fig. 2). An increase in air temperature or a decrease in air humidity increased the transpiration rate. CO_2 concentration and relative humidity or air temperature affected growth parameters independently in many cases, while the interaction between these factors was significant in some cases.

The **Ecosystem Study Section** studied 1) the effects of environmental stress on plants in transitional zones of lakes and wetlands, 2) the habitat of littoral zoobenthos, 3) the food-web structure in stream benthic communities and 4) the evaluation of modified river-beds for colonization by aquatic plants and animals.

The effects of land use in the areas surrounding Akaiyachi Mire on the mire ecosystem were investigated. The types of land use in the areas adjacent to the mire were paddy agriculture, fallow paddies and buckwheat agriculture with a deep trench. Groundwater

Fig. 2
Effects of CO₂ concentration and/or relative humidity on the growth and the transpiration of corn plants. Plants were treated for 5 days and the transpiration was measured just before harvest.



tables were monitored along five 90-m transect lines from the mire periphery inward. Groundwater tables were highest in early June and decreased towards September due to low precipitation during the summer. Along one transect, the groundwater table descended from the mire periphery, adjacent to a rice paddy, inward, suggesting that groundwater and nutrients were seeping from the paddies into the mire. Groundwater tables along the other transects were lowest at peripheral sites. The deep trenches in buckwheat fields seemed to cause the mire to dry up. Plant shoot heights were higher near the periphery than those at inner-mire sites (Fig. 3). Photosynthetic and transpiration rates of *Sasa palmata* were also high at peripheral sites. The descent of the groundwater table due to trench construction and the seepage of fertilizer from paddy fields seemed to expand the areas of *S. palmata* and *Pinus densiflora* in Akaiyachi Mire. These plants were not reported to be present in the mire 30 years ago.

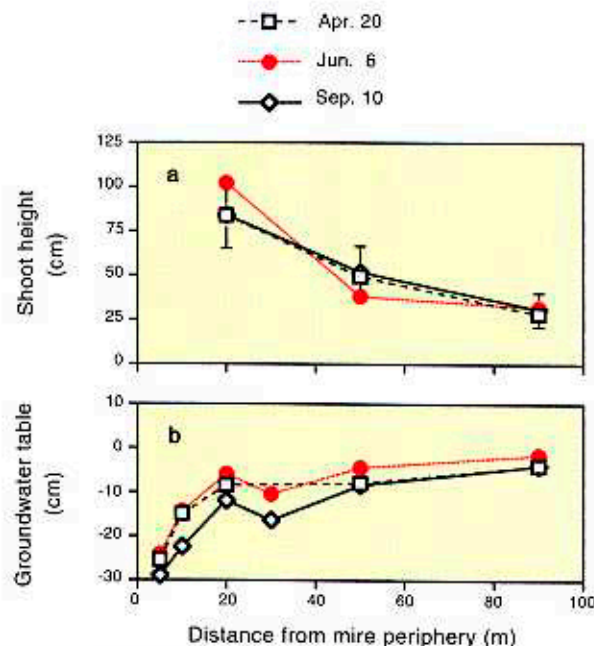


Fig. 3
(a) Mean height of *Sasa palmata* shoots 20, 50 and 90 m from the mire periphery.
(b) Horizontal changes in the groundwater table elevation.

Environmental Information Center



国立環境研究所

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The Environmental Information Center is responsible for various functions and services related to collection and provision of environmental information. Databases, a library, a supercomputer system and a general-purpose computer system are operated and maintained, enabling the handling of a wide range of environmental information.

Database Section

Processing and provision of data files of numerical environmental data

A wide range of numerical, environmental data is 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 which are transmitted by local governments to the Environment Agency under the Air Pollution Control Law and the Water Pollution Control Law. These data files are provided to outside users including other governmental organizations and laboratories. Also a duplication service for use by the general public is available for some files. Data files are also exchanged with other governmental organizations.

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 both understanding of present conditions and forecasting of changes in the natural environment. In the Phase 1 program, a database system (GREEN) was developed, using a general-purpose mainframe computer system, to enable searches for and display of environmental data from all over Japan. In FY 1995, the Phase 2 program for the adaptation of GREEN to personal computers (P-GREEN) was implemented based on previously recorded results and data.

NIES began in March 1996 to provide environmental information from NIES research activities and results (in English and in Japanese) to the world via the internet's world wide web (URL <http://www.nies.go.jp/>).

In March of 1996, the center established a computer communication system for the general public called the "Environmental Information Providing System" in accordance with the Basic Environment Law to promote national activities for conservation of the environment. This system is available, only in Japanese, via telephone, the internet or the Value-Added Network (VAN).

Surveys of environmental information have been in progress since FY 1992 with the goal of providing a directory of information sources in a form widely accessible to the general public. The surveys including information about where and in what mode environmental information is being accumulated (environmental information sources), explanations of laws, treaties, and terms concerning the environment were compiled on floppy disks and are being 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 for competent environmental research and environmental management. Database systems containing informative 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.

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

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

Library management and operations

As of March 1996, 34,674 books, 643 technical and scientific serials, 8,501 maps, 103,031 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

Report 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.

Information
Management
Section

INFOTERRA

INFOTERRA, the Global Environmental Information Exchange Network has been designed by UNEP to stimulate and support the exchange of environmental information between partners. The system is operated at the national level by national focal points. The center is designated as the INFOTERRA National Focal Point of Japan. As of March 1996, 171 countries had participated in INFOTERRA, and information sources registered in INFOTERRA numbered about 8,000 (511 in Japan).

Management and operation of computer and related systems

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/graphics 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.

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 Japanese registered users can remotely access the supercomputer system through NIESNET's connection to the internet via the Inter-Ministry Network (IMnet).

EI-NET

To enhance information exchange among many municipal and prefectural research organizations and the 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 180 users have subscribed to EI-NET.

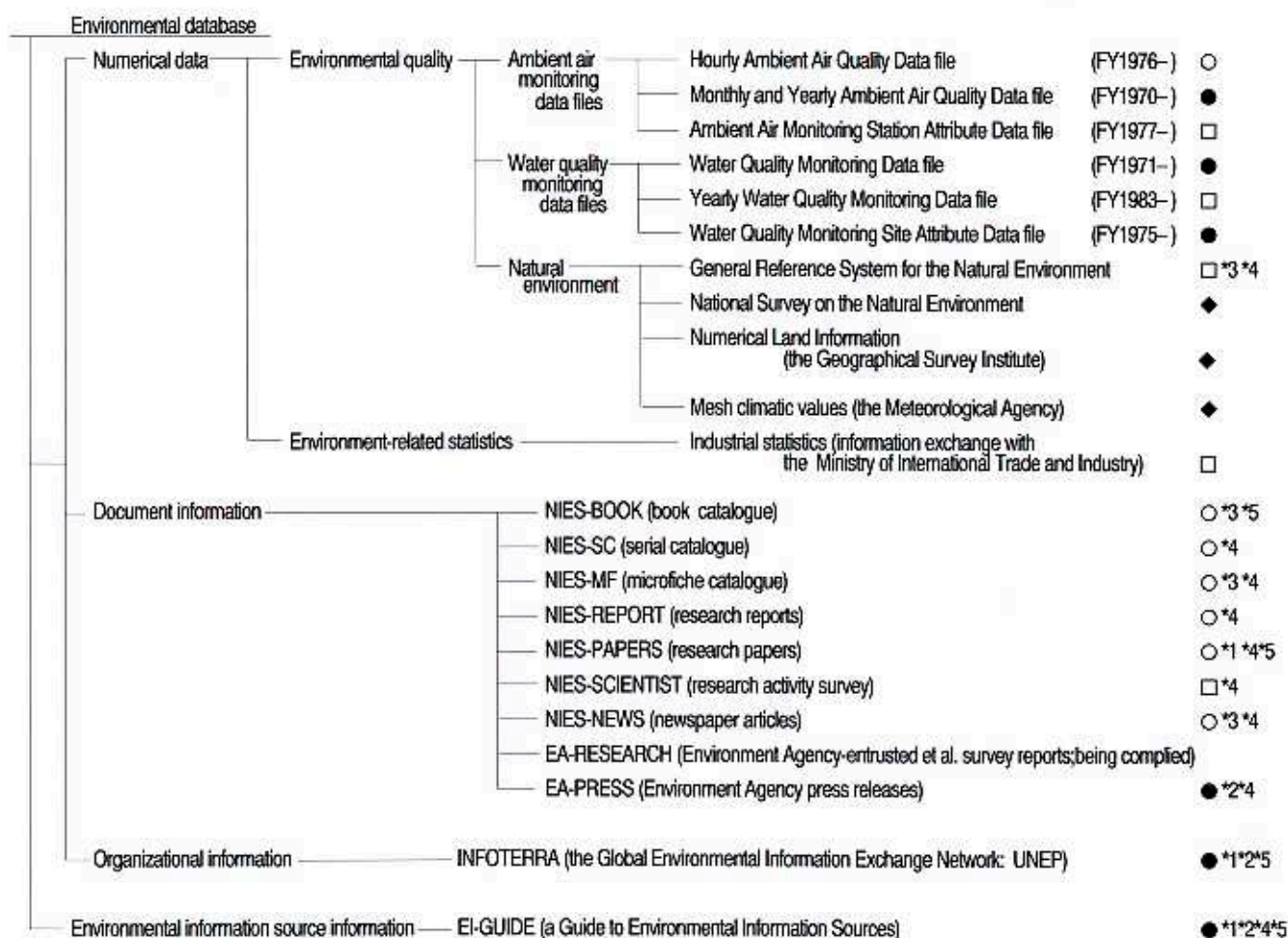


Fig. 1
Composition of NIES
Environmental
Databases

- 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 NIES World Wide Web Server (WWW)
 - *2 Environmental Information Providing System
 - *3 Available on the general-purpose computer system
 - *4 Available on personal computer systems
 - *5 Available on NIESNET

Center for Global Environmental Research



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 solution for our pressing environmental problems.

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

Research
Integration

The objectives of 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 in coordinating scientific and socio-economic research on global change; 3) to cooperate in international efforts to establish a research network for global change; 4) to 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 1995. Some, such as the annual Global Environment-Tsukuba, brought together researchers and decision makers with the general aim of furthering communication.

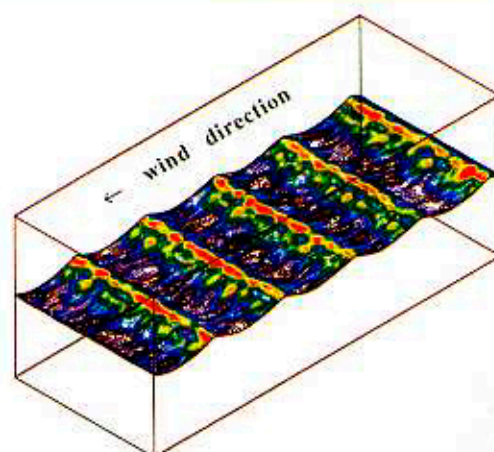
CGER also supported the efforts of groups seeking to organize workshops or symposia on specific research programs. In 1995, such groups included the International Geosphere-Biosphere Programme/Northern Eurasian Study project, the Tropical Rain Forest Research Project, and others.

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 for complementarity between these two approaches.

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). On 15 December 1995, the IPCC completed its Second Assessment Report, and CGER

Fig. 1
Sample simulation
results from the
Supercomputer
(Prediction of
instantaneous CO₂
concentration at a
sheared wavy air-water
interface (Nagaosa and
Komori 1995)).



made a significant contribution to the completion of the Working Group II, Working Group III, and synthesis reports. In addition, CGER has offered scientific consultation to the Eco-Asia and other projects 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. An annual activity report and monograph reports have been published by CGER to disseminate the advanced knowledge obtained by the users of the supercomputer (e.g., Fig. 1).

Integrated research on policy options

A special research category in the Environment Agency's Global Environment Research Program, Integrated Research, is made up of research directed towards actual decision making processes through the development of conceptual models and the generation of data used widely in interdisciplinary research. The following two research projects in this category have been implemented in 1995: 1) Studies on Environmental-Economic Integrated Assessment Methodologies for Sustainable Development, and 2) Design of a Global Environmental Information System for Sustainable Development.

Database Management

Database

CGER is establishing a global environmental database system as well as producing and distributing UNEP/GRID environmental data sets to support environmental research and decision making. During FY 1995, climate, trade statistics, and population data sets were collected to support environmental research such as environmental monitoring and research on global warming. The ease of use of two types of graphics software to visualize material flows were improved and manuals were prepared to facilitate their use by researchers. A Desertification Database was developed to assist decision makers and researchers in this specific field. It contains global desertification maps as well as desertification problems and countermeasures for several regions such as Africa, China, and India. A Coral Reef Database was also established for researchers working on global warming and it consists of a global coral reef distribution map, coral reef characterization based on Spot satellite images, and a bibliographic

database of coral reef research. The "Data Book of Sea-Level Rise" was published and distributed to the general public as well as researchers in this field. This book explains various aspects of sea-level rise in plain language as well as incorporating recent findings such as those reported in the IPCC Second Assessment Report in 1995.

GRID

The Global Resource Information Database (GRID) was established in 1985 within UNEP to provide timely and usable environmental data to the world community of researchers and policy makers. GRID-Tsukuba was founded at CGER in May, 1991, as the 8th GRID Center. During FY 1995, 105 data sets were distributed to users in and outside of Japan in response to 21 requests. There were 46 inquiries concerning the activities of GRID-Tsukuba and other GRID centers and all of them were addressed. Four Asian vegetation index maps, for 1987, 1988, 1989 and 1994, were registered as original data sets of GRID-Tsukuba and 1991 and 1992 maps were produced. As of March 31, 1996, GRID-Tsukuba can provide 40 data sets. GRID-Tsukuba's Internet Homepage was created and the pamphlet was revised. These media explain how to access GRID data sets.

Global Environmental Monitoring

CGER is measuring and recording data of various phenomena via long-term monitoring programs and makes these data available to interested parties both directly through the publication of data reports and also by providing our data for international data networks. The following 10 projects are presently coordinated by CGER.

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

CGER has been measuring the vertical profile of ozone concentration in the lower height of stratosphere above Tsukuba City with an ozone lidar. This instrument was installed in August 1988 and monitoring of the ozone layer commenced in October 1990. In FY 1995, measurements were made on 23 days and the resulting data have been submitted to the Network for the Detection of Stratospheric Change (NDSC). Millimeter wave measurement started in October 1995. Since then, the vertical ozone profiles through the whole stratosphere have been determined. A comparison of the millimeter wave measurement result with those from satellite and lidar data is planned.

Monitoring of UV-B

To reveal the trend of urban ultraviolet-B (UV-B) intensity of 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.

Japanese atmospheric monitoring stations (Hateruma Island and Cape Ochiishi)

The concentrations of greenhouse gases (GHGs) at our stations are continuously monitored to observe 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 conditions in the southern Japan region. Monitoring at Hateruma started in October 1993. To obtain atmospheric background data for the northern region of Japan, monitoring at Cape Ochi-ishi, Hokkaido commenced in September 1995.

Monitoring of GHGs in Siberian Wetlands by chartered airplane

The release of methane from frozen Siberian wetlands is expected to accelerate global warming. CGER used an airplane to evaluate the methane efflux from Siberian wetlands as a part of cooperative research projects with Russia. The plane sampled broad areas to investigate horizontal distribution of methane for 3 years (1992-1994) and results were interesting. In FY 1995, the project intended to determine the altitudinal distribution of methane by sampling air at different heights from an airplane flying above Surgut and Yakutsk.

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 8 times a year regularly between Japan and Australia. Such samples are gathered and sent to CGER's laboratory every sailing for high precision determination of GHGs such as CO₂, CH₄, and N₂O. The resulting data are useful in the study of the global carbon cycle (Fig. 2).

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

CO₂ 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. For estimating the net rate of atmosphere-ocean CO₂ exchange, CGER installed instruments on a cargo ship in FY 1995 to measure automatically CO₂ partial pressure in air and surface sea water while sailing regularly between Canada and Japan (Fig. 3).

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

The cycles of chemical 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

Fig. 2

3-D display of the latitudinal distribution and annual trend of CO₂ concentration in the atmosphere over the western Pacific Ocean. Samples are taken by an automatic bottle sampling unit with cooperation of a container cargo ship, M/S Hakubamaru, NYK Line Co.

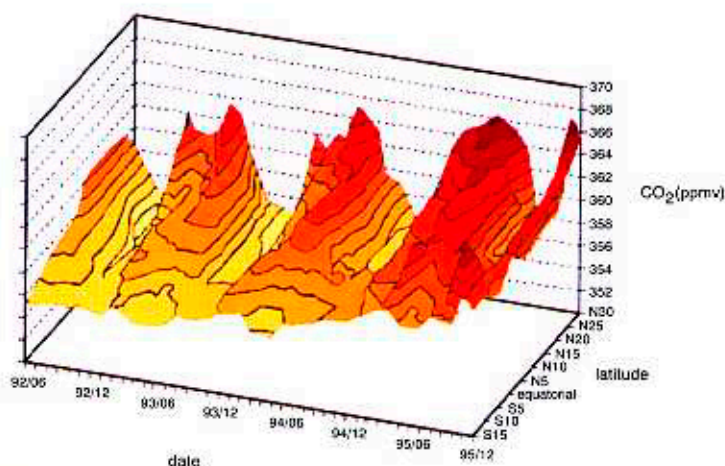


Fig. 3

M/S Skaugran, an our ship of opportunity belonging to Jahre-Wallem Management AS (Norway). While sailing between Canada and Japan, this lumber transport ship measures CO₂ partial pressure in air and sea water.



impacted the ocean through the marginal seas. CGER has measured P, N, Si, chlorophyll a, and pheopigments in the continuous water intake of a ferry boat sailing regularly on two lines (Osaka-Okinawa and Osaka-Beppu) since March 1994.

Mapping 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 satellite 1996. Establishment of an ILAS & RIS Data Handling Facility (DHF) is the responsibility of CGER 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.

During FY 1995, the full-scale development of the software system on the actual computer system for the ILAS & RIS DHF at CGER proceeded, on the basis of a conceptual design which had been developed over the previous several years.

GEMS/Water Programme

GEMS/Water was organized jointly under the United Nations Environment Programme (UNEP) and the World Health Organization (WHO). A network of 20 stations in Japan has been established for GEMS/Water Phase II activities. In particular, Lake Mashu, has been registered as a network site. CGER is responsible for coordinating GEMS/Water data transmissions, etc., as the Japanese National Center (focal point). CGER also participates in an Analytical Quality Control (AQC) Programme by providing certified reference materials (CRMs) of river sediments to laboratories analyzing samples from the global flux stations of the world.

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 practical experience to 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 24,000 participants from national, prefectural and metropolitan governmental organizations. In July 1990, in order to create a closer link between training and research, the institute was united with the National 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 from which trainees are dispatched to our training programs 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 semi-governmental 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 those from chartered semi-governmental corporations with special status, comprising 10%. Recently, the number

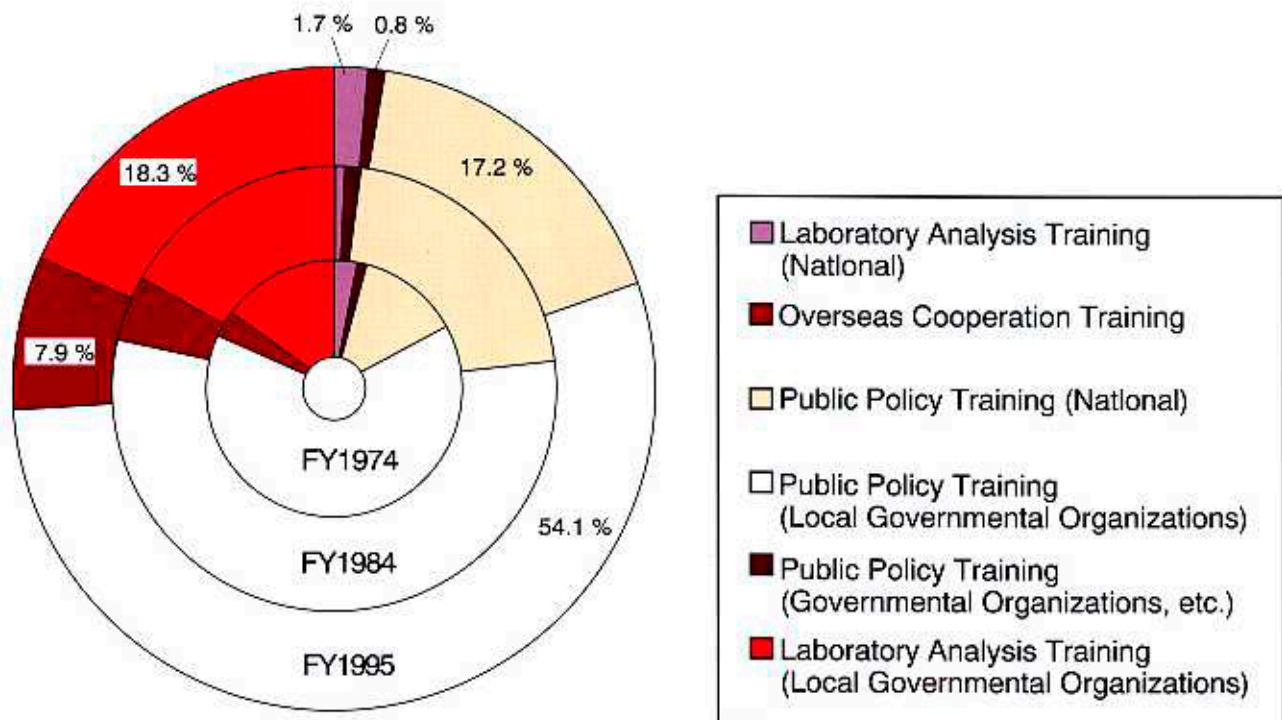


Fig. 1 Changes in the percentages of participants from various sectors.

Public Policy Courses

Course Name	Length (days)	Number of Participants
Seminar for Environmental Bureaucratic Management/Directors	5	46
Local Environmental Training course	6	72
Environmental Impact Assessment Training Course	6	118
Environmental Education Training Course (Government)	5	54
Environmental Education Training Course (Practicum)	3	23
The Basic Environment Plan Training Course	5	78
Training Course for Leaders of Overseas Training Programs	5	13
Training Course for Global Environmental Conservation Technology	8	38
Nature Conservation Training Course	6	70
Wildlife Protection Training Course	5	51
National Park Management Training Course	5	41
Air Pollution Control Training Course	6	78
Noise and Vibration Control Training Course	5	98
Water Pollution Control Training Course	6	104
Grand Subsidence Control Training Course	5	33
Information Management Training Course	8	30
Training Course for Environment Agency Employees (Staff Class)	5	20
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	19
Training Course for Newly Assigned Regional Environmental Intelligence Officers	4	12
Sub Total	110	1013

Laboratory Analysis Courses

Course Name	Length (days)	Number of Participants
Instrument Analysis Training Course	13	40
General Analysis Training Course	8	33
Air Analysis Training Course	13	28
Water Analysis Training Course	13	48
Instrument Analysis Training Course (Special Program A1)	5	22
Instrument Analysis Training Course (Special Program A2)	5	13
Instrument Analysis Training Course (Special Program B)	5	11
Special Topic Analysis Training Course	-	0
Thematic Analysis Training Course (1) Periphytic Algae	5	10
Thematic Analysis Training Course (2) Plankton	5	19
Thematic Analysis Training Course (3) Effluvia	5	16
Thematic Analysis Training Course (4) Benthic Fauna	5	16
Sub Total	82	256

International Cooperation Courses

Course Name	length (days)	Number of Participants
Environmental Monitoring (Water Quality) Training Course	32	10
Ground Total	224	1279

of participants from developing nations and a few other countries has also been on the rise. In addition, the institute has begun to support training programs implemented by prefectural and metropolitan governmental organizations, in response to the rapidly increasing need for training and new developments in environmental administration due to the implementation of the Basic Environment Law in 1993.

The "Investigative Committee for the Future Status of the National Environmental Training Institute" (commissioned by the Chief of the National Planning and Coordination Bureau of the Environment Agency) was formed in February 1994 to comprehensively study NETI's mandate over the medium to longterm. This committee is composed of experienced academics and other professionals. In April 1995, the "Medium and Long-term Prospects" white paper was completed. In the years ahead, the institute will strive to develop human resources in the environmental sector based on the guidelines proposed in this white paper.

In addition, the institute will train experts to assist in solving environmental problems in developing countries. For this training, the institute will be equipped with new facilities including analytical laboratories, an internet room and an international conference room.

List of Major Research Subjects

<Global Environment Research Projects>

- Mechanisms of global warming caused by the increase of greenhouse gases**, Nojiri, Y., 1990-1998
- 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., 1990-1995
- Maintenance mechanisms of tropical forest ecosystems**, Furukawa, A., 1993-1995
- Effects of habitat fragmentation on biological diversity**, Tsubaki, Y., 1991-1996
- Human dimension of global environmental change**, Nishioka, S., 1994-1997
- Integrated studies for conserving the global environment**, Nishioka, S., 1990-1997
- Satellite remote sensing**, Sasano, Y., 1989-2002

<Special Research Projects>

- Application of biotechnology to preservation of the environment and evaluation of its effects**, Kondo, N., 1991-1995
- Characteristics of wetland ecosystems and their resilience in the face of 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**, Shiraishi, H., 1994-1997
- Biomonitoring methodology for ecological risk assessment of chemical substances**, Hatakeyama, Shigehisa; 1995-1997

<International Joint Research Projects>

- 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
- Community change and ecosystem management of shallow, eutrophic lakes**, Takamura, N., 1995-1999

<Others>

- Development of bioeffect sensors for environmental chemicals**, Mochitate, K., 1995-1999
- Paleoenvironmental studies of Baikal sediment cores**, Kawai, T., 1995-1999
- Vehicular research to mitigate environmental pollution**, Shimizu, Hiroshi; 1994-1996
- Path controls for bulk data transmission on the IMnet**, Abe, S., 1994-1996
- Development of advanced, sustainable water and waste water treatment systems**, Inamori, Y., 1995-1997

Global Environment Tsukuba '95

– A New Frontier of Global Environmental Research: Human Dimensions of Global Environmental Change Programme –

September 8, 1995
Toranomon Hall, Tokyo,
Japan

Close connections and collaboration between natural and social sciences/scientists are essential for resolving global environmental problems. The aim of this international meeting was to initiate and promote research projects with such an interdisciplinary nature, especially in Japan. The meeting was supported by the Center for Global Environmental Research, NIES and the Research and Information Office, Global Environment Dept., Japan Environment Agency. 213 participants including Prof. Urs Luterbacher from HDP headquarters and Dr. Thomas J. Baerwald from US-NSF attended and over 10 lectures were presented. A panel—What is the Japanese target in HDP—chaired by Prof. A. Amano, rounded off the meeting. The output of the meeting contributed to the development of an HDP funding sub-category in JAE's Global Environment Research Program.

UNU Conference on the Sustainable Future of the Global System

October 16-18, 1995
United Nations
University, Tokyo,
Japan

This conference was organized by the United Nations University/Institute of Advanced Studies (UNU/IAS) in cooperation with NIES as an effort to provide a forum on alternative scenarios of the sustainable future of the global system, and also to discuss key issues in sustainable development. Included in the conference were analyses of medium to long-term global scenarios of environmental impacts of economic development as well as scenarios of sustainable economic development in the context of global resource constraints. There were over 150 participants from more than 15 countries—both developed and developing countries—as well as international organizations such as IASA. The meeting approved of the development of the international research network on the sustainable development.

ILEC Post Congress Meeting – Ecosystem Structures and Matter Flow of Shallow Lakes

October 30-31, 1995
NIES, Tsukuba,
Japan

Researchers from the South Florida Water Management district (Florida), the Institute of Hydrobiology (Wuhan), and the National Institute for Environmental Studies (Tsukuba) presented studies of the ecosystems of Lake Okeechobee (Florida, USA), The East Lake (Hubei, China) and Lake Kasumigaura (Ibaraki, Japan). We discussed the similarities and differences of ecosystem structure and function among the three lakes, and characterized the ecosystems of these large and shallow lakes. Problems for future study were identified and measures for the conservation of water quality and ecosystem integrity of these lakes were proposed.

International Symposium on the International Geosphere-Biosphere Programme – Northern Eurasia Study (IGBP-NES)

November 27-
December 1, 1995
NIES, Tsukuba,
Japan

The ecosystems in Siberia are thought to be seriously affected by global changes such as global warming. There are also possibilities of the feedback effects of changes of the ecosystems on the global environment. Three IGBP core projects, IGAC, BAHC and GCTE planned to initiate a new inter-core regional project, IGBP Northern Eurasia Study. This meeting was one of the initiating meetings for the project and the first for implementation of the project. 84 scientists from 12 countries, including 12 from Russia, attended the meeting. There were 5 sessions focused on the specific objectives and one session for linkages and integration between the objectives. Some research sites in both eastern and western Siberia were designated and research groups were coordinated.

The 4th International Workshop on the Harmonization of the Monitoring Techniques for Acidic Deposition, and Methodology of Emission Inventories of SO₂ and NO_x in East Asia

February 13-15, 1996
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 and data exchange which are needed to clarify the air pollution situation in East Asia.

COUNTRY

No. Title

Collaborating Institution
NIES Partner

AUSTRALIA

1. Biogeochemical studies on the trace elements in marine environments
Western Australian Marine Research Lab.
Environmental Chemistry Div.
2. Development of new methodologies to assess physiological effects of environmental pollutants
Dept. Biochemistry, Univ. Tasmania
Environmental Health Sciences Div.
3. Cooperative research on global environmental monitoring
CSIRO
Atmospheric Environment Div.

CANADA

1. Monitoring of the atmosphere-ocean carbon dioxide exchange rate
Center for Ocean Climate Chemistry, Institute of Ocean Sciences
Global Environment Div.
2. Eco-physiological studies on picophytoplankton in lakes
West Vancouver Lab.
Regional Environment Div.
3. Arctic atmosphere under polar sunrise
Atmospheric Environment Service
Environmental Chemistry Div.
4. Elucidation of the cycling and transformation of chemical substances in the North Pacific Ocean
Dept. Chemistry, Univ. British Columbia
Environmental Chemistry Div.

CHINA

1. Biogeochemical studies on the acidic deposition and pollutions in the terrestrial and aquatic ecosystems
China-Japan Friendship Environmental Protection Center
Global Environment Div.
2. Cooperative research on acid rain in East Asia
Peking Univ.
Global Environment Div.
3. Identifying groundwater pollution sources by nitrogen isotopes
Zhongshan Univ.
Regional Environment Div.
4. Investigation on toxic chemicals in China
China-Japan Friendship Environmental Protection Center
Regional Environment Div.
5. Advanced wastewater treatment processes for China
Research Institute for Environmental Engineering/Dept.
Environmental Engineering, Tsinghua Univ.
Regional Environment Div.
6. Industrial wastewater treatment processes and water quality renovation technology for eutrophied lakes in China
Wuhan Environmental Protection Agency
Regional Environment Div.

7. Development of advanced on-site domestic wastewater treatment systems for China
Chinese Research Academy of Environmental Sciences
Regional Environment Div.
8. Advanced sewage treatment processes by soil system applicable to China
Institute of Applied Ecology, Chinese Academy of Sciences
Regional Environment Div.
9. Development of wastewater and water resources treatment processes applicable to China
Chinese Research Academy of Environmental Sciences
Regional Environment Div.
10. Urban atmospheric pollution in China
China-Japan Friendship Environmental Protection Center
Regional Environment Div.
11. Remote sensing of forest vegetation dynamics in southwest China
Institute of Mouton Hazards and Environment
Social Environmental Systems Div.
12. Preparation and evaluation of environmental certified reference materials
China-Japan Friendship Environmental Protection Center
Environmental Chemistry Div.
13. Stable isotope ratios of lead and sulfur in the atmosphere in Japan and China: Sources and cross-boundary transmission of air pollutants
Institute of Geochemistry
Environmental Chemistry Div.
14. Development of monitoring method and surveillance of dry deposition
China-Japan Friendship Environmental Protection Center
Atmospheric Environment Div.
15. Cooperating study of the East China Sea monitoring and preservation of the life species diversity
Dept. International Cooperation, State Oceanic Administration /East China Sea Fisheries Research Institute
Water and Soil Environment Div.
16. China-Japan cooperative research on natural resources and environmental accounting
Development Research Center
Center for Global Environmental Research

FINLAND

1. Accumulation of heavy metals by bryophytes in acidic environments
Dept. Botany, Helsinki Univ.
Global Environment Div.

FRANCE

1. Ozone layer observation from satellite
Lab. Physique Moleculaire et Applications, CNRS/Univ.
Pierre et Marie Curie
Global Environment Div.
2. Assessment of lung injury by air pollutants
Unite de Biologie Moleculaire, Hospital Armand
Trousseau
Regional Environment Div.

3. Environmental noise control
Lab. Acoustique, Univ. Maine
Social Environmental Systems Div.

GERMANY

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

ISRAEL

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

ITALY

1. Fate of pesticides in environments and their effects on
ecosystems
Faculty of Agriculture, Univ. Mirano
Global Environment Div.

KOREA

1. Aircraft and ground-based observations of acidic and/or
oxidative pollution in East Asia
Environment Research Center, Korean Institute of
Science and Technology
Global Environment Div.
2. Monitoring of ocean environmental parameters from a Japan-
Korea ferry boat
Korea Ocean Research and Development Institute
Global Environment Div.
3. Cooperation for monitoring organochlorine pesticides and
PCB in the Japan Sea
Korea Ocean Research and Development Institute
Environmental Chemistry Div.
4. Quantification of personal ultraviolet irradiation and its
health effects
Gyeong-Sang National Univ.
Environmental Health Sciences Div.
5. Development of urban scale air pollution model
National Institute of Environmental Research
Atmospheric Environment Div.

NORWAY

1. Studies on analyses of observed data of the stratospheric
ozone layer
Norwegian Institute for Air Research
Global Environment Div.
2. Trophic interactions in lake and wetland ecosystems in
relation to their conservation and management
Norwegian Institute for Nature Research
Environmental Biology Div.
3. Global environmental database
GRID-Arendal
Center for Global Environmental Research

RUSSIA

1. Research programs under the Baikal International Center for
Ecological Research
Limnological Institute, Russian Academy of Sciences
Environmental Chemistry Div.
2. Airborne measurement of greenhouse gases over Siberia
Central Aerological Observatory
Atmospheric Environment Div.
3. Modeling of methane emission rates from natural wetlands
Institute of Microbiology
Atmospheric Environment Div.
4. Measurement of methane emission rates from permafrost
areas
Permafrost Institute
Atmospheric Environment Div.
5. 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 Div.
6. Comparative studies on the structure of fresh water
ecosystems in the Far East
Institute of Biology and Pedology, Far East Branch
Environmental Biology Div.
7. Assessment of the effects of hazardous chemicals on aquatic
ecosystems
Irkutsk State Univ.
Environmental Biology Div.

SPAIN

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

SWEDEN

1. Development of risk assessment methodologies using in vitro
toxicity testing
Dept. Toxicology, Uppsala Univ.
Environmental Health Sciences Div.
2. Health risk assessment of heavy metal exposure: Effects of
increase in human activity
Karolinska Institute
Environmental Health Sciences Div.

U. K.

1. Quality assurance and international harmonization of marine environmental analysis
Dept. Agricultural and Fisheries for Scotland, Marine Lab.
Regional Environment Div.
2. Solubilization of toxic heavy metals from man-made objectives by acid rain
Dept. Earth Science, Univ. Sheffield
Regional Environment Div.
3. In vivo NMR spectroscopy method and its application to the field of environmental health
Dept. Biochemistry, Univ. Cambridge
Environmental Health Sciences Div.
4. Effects of environmental pollution on the metabolism of trace elements in man
Rowett Research Institute
Environmental Health Sciences Div.
5. Studies on the maintenance mechanism of biodiversity in aquatic ecosystems
Sch. Biological Science., Queen Mary and Westfield Coll., Univ. London
Environmental Biology Div.
6. Algae and Protozoa
CCAP, Institute of Freshwater Ecology
Environmental Biology Div.

U. S. A.

1. Monitoring long-term change in biodiversity
Dept. Biology, Univ. New Mexico
Global Environment Div.
2. Preparation and evaluation of certified reference materials for marine monitoring
NOAA
Regional Environment Div.
3. Development of simulation models for health risk assessment of toxic compounds
Sch. Hygiene and Public Health, Johns Hopkins Univ.
Regional Environment Div.
4. Ecological and physiological aspects of methanotrophs
Dept. Microbiology, Biochemistry and Molecular Biology, Univ. Maine
Water and Soil Environment Div.
5. Development of bioremediation technologies for cleanup of contaminated soil
Center for Environmental Biotechnology, Univ. Tennessee
Water and Soil Environment Div.
6. Precise measurement of the greenhouse gases in the global baseline atmosphere
Climate Monitoring and Diagnostics Lab, NOAA
Center for Global Environmental Research

CANADA

Agreement between National Institute for Environmental Studies and Institute of Ocean Sciences (1995).

CHINA

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

Agreement on cooperative research projects between the National Institute for Environmental Studies, Environment Agency of Japan and the Institute of Hydrobiology, Chinese Academy of Sciences (1995).

Memorandum of understanding between Institute of Hydrobiology, Chinese Academy of Sciences, Peoples's Republic of China (IHBCAS) and National Institute for Environmental Studies, Japan (NIES) for collaborative research on microalgal toxicology, systematics and culture collection operations (1995).

INDIA

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

KOREA

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

Implementing Arrangement between the National Institute for Environmental Studies of Japan and the National Institute of Environmental Research of the Republic of Korea to establish a cooperative framework regarding environmental protection technologies (1988, and revised in 1994).

MALAYSIA

Memorandum of Understanding between the Forest Research Institute Malaysia (FRIM), the University Pertanian Malaysia (UPM) and the National Institute for Environmental Studies, Japan (NIES) for Collaborative Research on Tropical Forests and Biodiversity (1991, and revised in 1995).

RUSSIA

Agreement on a Joint Geochemical Research Program; Impact of Climatic Change on Siberian Permafrost Ecosystems between the Permafrost Institute, Siberian Branch, Russian Academy of Sciences, Russia and the National Institute for Environmental Studies, Japan (1992).

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

THAILAND

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

UN

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

<Host Division>

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

<Global Environment Division>

- Dubovik, Oleg Vyacheslavovich, BELARUS, 1995. 2. 2~**
 Inversion algorithm studies for ILAS (Sasano, Y.)
- Hooper, Rowan Earle, U. K., 1995. 3. 31~**
 Studies on sexual selection and mate choice in Calopterigidae (Tsubaki, Y.)
- Lee, Dong Kun, KOREA, 1995. 11. 1~1996. 3. 31**
 Development of Korean Module of Asian-Pacific Integrated Model (AIM/Korea) (Morita, T.)
- Lukyanov, Alexander, RUSSIA, 1996. 3. 26~1996. 5. 26**
 Analysis of the data of the balloon experiment of the Ozone layer at Yakutsk in East Siberia using 1D model (Nakane, H.)
- Sharma, Vinod Kumar, INDIA, 1995. 7. 1~**
 Development of Indian Module of Asian-Pacific Integrated Model (AIM/India) (Morita, T.)
- Siva-Jothy, Michael Trevor, U. K., 1995. 8. 1~1995. 8. 26**
 Studies on reproductive systems of dragonflies (Tsubaki, Y.)
- Sodhi, Navjot Singh, CANADA, 1995. 1. 18~1995. 12. 22**
 The effect of population structure on genetic diversity in wildlife conservation (Nagata, H.)
- Xu, Kai Qin, CHINA, 1995. 6. 6~**
 Studies on Practical Control System of SO₂ and NO_x and Development of the Comprehensive Model of Acid Precipitation in East Asia (Murano, K.)
- Zeng, Jiye, CANADA, 1995. 8. 21~1996. 3. 31**
 Measurement of air-sea exchange of greenhouse gases (Nojiri, Y.)

<Regional Environment Division>

- Albinger, Otto, AUSTRIA, 1995. 11. 1~**
 The role of bacteria and the interrelationships between bacteria and other organisms in freshwaters (Takamura, N.)
- Bland, Colby David, CANADA, 1995. 2. 27~1995. 8. 28**
 Analysis of drive system and body design for Eco Vehicle (Shimizu, H.)
- Chan, Lam, U. K., 1995. 3. 27~1995. 11. 24**
 Research on the algorithm of auto-drive systems for Eco Vehicle (Shimizu, H.)
- Chang, Il-Kuk (Zhang Yiguo), CHINA, 1995. 8. 1~1996. 3. 31**
 Studies on in vitro Cultivation, Freezing Method and Transfer of Avian Primordial Germ Cells (Takahashi, S.)
- Deb, Swapan Chandra, INDIA, 1996. 2. 1~**
 Relationship between aquatic ecosystem and nutrient cycle (Fukushima, T.)
- Di, Sun, CHINA, 1995. 5. 15~1996. 3. 31**
 Pesticide effects on zooplankton communities (Hanazato, T.)
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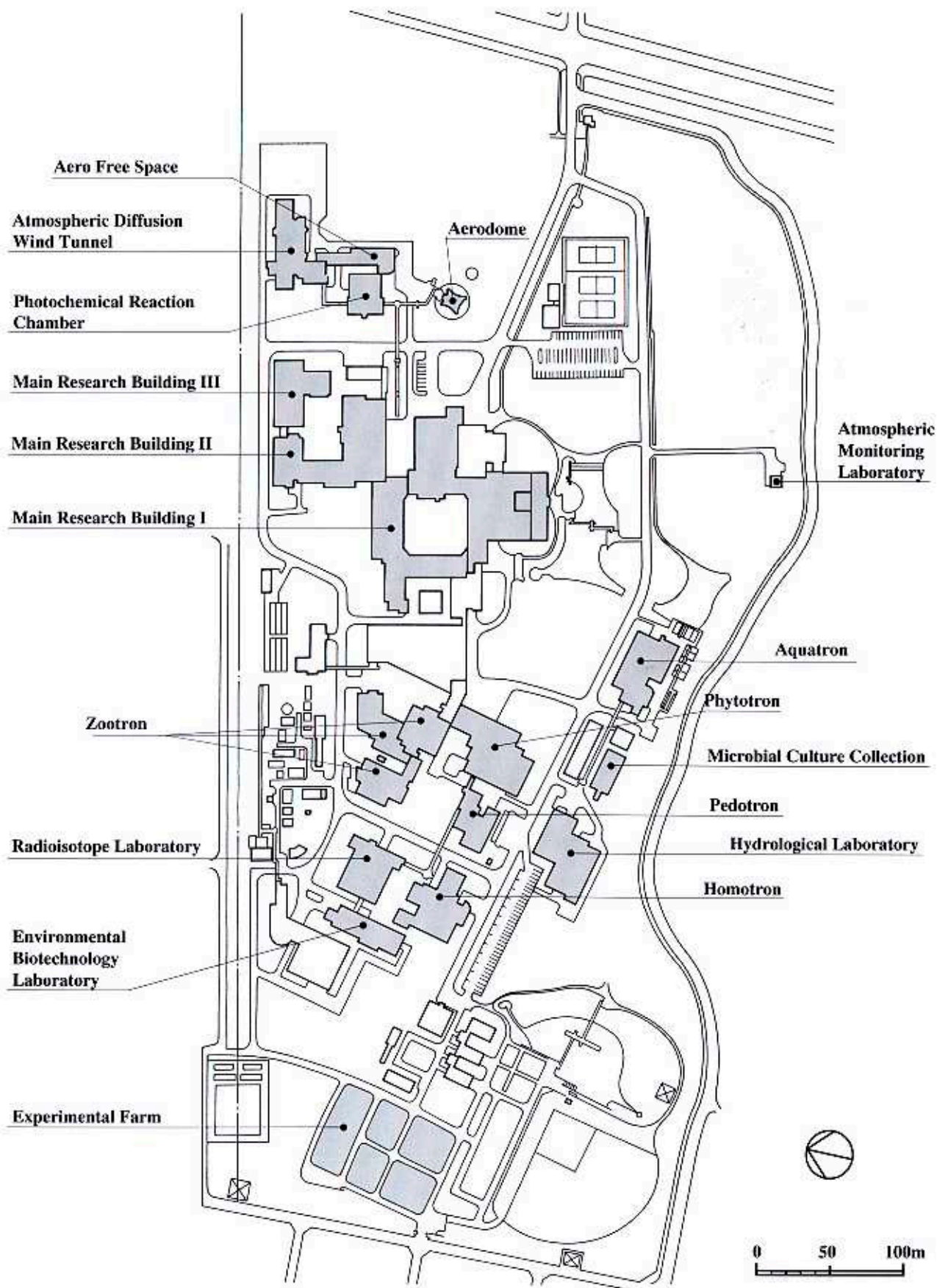
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Aerodome

The aerodome is a facility both for remote monitoring of pollutant particles in the atmosphere (via a large-scale laser radar) and for study of the formation of secondary particulates from gaseous primary pollutants. The laser radar can rapidly and sensitively scan, with computer controlled pointing, both tropospheric and stratospheric aerosols at any angle above the horizon. The 4 m³ 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.

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.

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.

Atmospheric Diffusion Wind Tunnel

This wind tunnel is exceptional in that wind velocities (down to 0.2 m s⁻¹), air temperatures and floor temperatures can be independently controlled to create stratified flow fields. Temperature and wind velocity sensors are moved through the tunnel on a computer controlled traverse system gathering 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.

Atmospheric Monitoring Laboratory

Automatic instruments to monitor the concentrations of seven atmospheric constituents (NO_x, SO₂, O₃, CO₂, 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.

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.

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.

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 CO₂ dynamics and elemental cycles.

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.

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.

Main Research Building III

The third of NIES's main research buildings was completed during FY 1995 and includes advanced spectrometers, a hazardous chemicals area, satellite remote sensing equipment, an eco-office and so on.

1) Fourier-Transform Mass Spectrometer (FT-MS)

FT-MS has very high mass resolution of more than 10^6 at $m/z=131$ with a superconducting magnet rated at 3 Tesla. Ions are supplied to this instrument by electron impact ionization (EI) and chemical ionization (CI) and also from an external ionization chamber with an ion acceleration lens system. Cluster ions with high mass numbers, isotopes/isobars and reaction of radicals and ions can be measured with very high mass resolution.

2) Tandem Mass Spectrometer (Tandem-MS)

Two double-focus type mass spectrometers, each with a resolution of 65,000, are connected serially (in tandem). The ions selected by the first mass spectrometer are modified by electron impacts and other reactions in the interface area and the resulting ions are analyzed by the second mass spectrometer. The chemical structures of complex molecules can be analyzed with this technique.

3) Accelerator Mass Spectrometer (AMS)

An electrostatic tandem accelerator of 5,000,000 V (max.) terminal voltage is interfaced with two ion sources and an analytical mass spectrometer system. The AMS is installed and isolated in a radioactivity controlled area. Isobaric atomic ions, which have the same mass number but different atomic numbers, can be distinguished by the electric charges of their nuclei. The AMS is a very sensitive and selective method for atomic ion detection and it is used for measurements of long-lived radioisotopes such as ^{14}C and ^{36}Cl . These radioisotopes are used as tracers and time-makers (dating agents) in environmental research.

4) Hazardous Chemicals Area

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

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

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

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

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

7) Eco-Office

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

8) Reception and Processing Facility for NOAA Satellite Data

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

9) Information Processing Center for GRID-Tsukuba

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

Microbial Culture Collection

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

Oku-Nikko Field Monitoring Station

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.

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.

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.

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.

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 $^{36}\beta$ and γ emitting isotopes is permitted but the use of α emitters is forbidden.

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.

Present Number of Personnel

Director General	1
Deputy Director General	1
Research Coordinators	5
General Affairs Division	39
Global Environment Division	24
Regional Environment Division	43
Social and Environmental Systems Division	15
Environmental Chemistry Division	18
Environmental Health Sciences Division	19
Atmospheric Environment Division	19
Water and Soil Environment Division	15
Environmental Biology Division	16
Environmental Information Center	18
Center for Global Environmental Research	9
Environmental Training Institute	18
Total	260

Field of Expertise

Basic Sciences	83
Engineering	44
Agricultural Sciences	20
Medical Science	16
Pharmacology	7
Fisheries Science	3
Economics	2
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, Kunihiro	2304	kyamazak
		Research Coordinator	SAKAMAKI, Fumio	2305	
		Research Coordinator	SHIMIZU, Hideyuki	2306	hshimizu
		Research Coordinator	SUGIYAMA, Ken-ichiro	2307	kensugi
		International Coordination Researcher	UEHIRO, Takashi	2309	uchiro
		International Research Coordinator	YAMAMURA, Mitsuru	2308	mitsury
General Affairs Division					
		Director	OKADA, Hideo	2311	
	General Affairs Section	Chief	KIDOKORO, Kazuo	2312	
	Accounting Section	Chief	ASANO, Noboru	2319	
	Facility Section	Chief	MORITA, Fujitaka	2325	
Global Environment Division					
		Director	NISHIOKA, Shuzo	2331	nishiok
		Independent Senior Researcher	MURANO, Kentaro	2537	murano
	Global Warming Mechanism Research Team	Leader	NOJIRI, Yukihiro	2499	nojiri
			TAKENAKA, Akio	2474	takenaka
			MUKAI, Hitoshi	2536	lmukaih
			MACHIDA, Toshinobu	2525	tmachida
	Global Warming Response Research Team	Leader	MORITA, Tsuneyuki	2541	t-morita
			KAINUMA, Mikiko	2422	mikiko
			KAI, Keiko	2524	masuda
	Ozone Layer Research Team	Leader	NAKANE, Hideaki	2491	nakane
			AKIYOSHI, Hideharu	2393	hakiyosi
	Acid Deposition Research Team	Leader	SATAKE, Kenichi	2447	ksatake
			HATAKEYAMA, Shiro	2502	hatashir
	Marine Environment Research Team	Leader	HARASHIMA, Akira	2508	harashim
			KUNUGI, Masayuki	2434	kunugi
			HARADA, Shigeaki	2509	sharada
	Natural Vegetation Conservation Research Team	Leader	OKUDA, Toshinori	2426	okuda
			TANG, Yanhong	2483	tangyh
			ADACHI, Naoki	2481	nadachi
	Wildlife Conservation Research Team	Leader	TSUBAKI, Yoshitaka	2482	tsubaki
			TAKAMURA, Kenji	2470	takakcn
			NAGATA, Hisashi	2493	hnagata
	Satellite Remote Sensing Research Team	Leader	SASANO, Yasuhiro	2444	sasano
			SUZUKI, Makoto	2460	m-suzuki
			YOKOTA, Tatsuya	2550	yoko
Regional Environment Division					
		Director	MORITA, Masatoshi	2332	mmorita
		Deputy Director	KABUTO, Michinori	2333	kabuto
		Independent Senior Researcher	KASUGA, Seiichi	2425	
		Independent Senior Researcher	MATSUMOTO, Yukio	2529	y-matsu
		Independent Senior Researcher	NAKAJIMA, Koki	2489	
		Independent Senior Researcher	TAKESHITA, Shunji	2473	

Traffic Pollution Control Research Team				
Leader	SHIMIZU, Hiroshi	2453	hiro	
	KONDO, Yoshinori	2441	kondos	
Urban Air Quality Research Team				
Leader	WAKAMATSU, Shinji	2554	wakamatu	
	UEHARA, Kiyoshi	2409	kuehara	
Coastal Environment Research Team				
Leader	KOHATA, Kunio	2438	kohata	
	NAKAMURA, Yasuo	2492	yasuo	
Lake Conservation Research Team				
Leader	FUKUSHIMA, Takchiko			
	MATSUSHIGE, Kazuo	2527	matusige	
Hazardous Waste Research Team				
Leader	SHIRAIISHI, Hiroaki	2455	hiroshira	
	NISHIKAWA, Masataka	2495		
Water Quality Renovation Technology Research Team				
Leader	MORIGUCHI, Yuichi	2540	moriguti	
	MATSUHASHI, Keisuke	2511		
Air Pollutants Health Effects Research Team				
Leader	SAGAI, Masaru	2443	sagai	
	ICHINOSE, Takamichi	2397	ichinose	
	TAKANO, Hirohisa	2466	takano	
Chemical Exposure and Health Effects Research Team				
Leader	SOMA, Yuko	2463	yukosoma	
	YONEMOTO, Junzo	2553	yonemoto	
	TAKAGI, Hiroo	2465	takakiho	
	INABA, Kazuho	2399	inabakz	
	SONE, Hideko	2464	hsone	
Ecological Hazard Assessment Research Team				
Leader	HATAKEYAMA, Shigehisa	2503	hata-tox	
	KASAI, Fumie	2424	kasai f	
	SUGAYA, Yoshio	2458	sugaya	
Biotechnology Products Assessment Research Team				
Leader	YAGI, Osami	2542	yagiosa	
	NAKAJIMA, Nobuyoshi	2490	naka-320	
	IWASAKI, Kazuhiro	2407	kiwasaki	
Urban Environment and Health Research Team				
Leader	KABUTO, Michinori	2427	kabuto	
	TAKAHASHI, Shinji	2467	stakahashi	
	NITTA, Hiroshi	2497	nitta	
	KAGEYAMA, Takayuki	2423	kage	
	IMAI, Hideki	2404	imahide	
International Health Effects Research Team				
Leader	ANDO, Mitsuru	2395	mando	
	HIRANO, Seishiro	2512	seishiro	
	YAMAMOTO, Shoji	2548	sn Yamamo	
International Water Environment Renovation Research Team				
Leader	INAMORI, Yuhei	2400	inamori	
	MIZUOCHI, Motoyuki	2496		
International Ecosystem Management Research Team				
Leader	TAKAMURA, Noriko	2471	noriko-t	
	FUKUSHIMA, Michio			
Social and Environmental Systems Division				
Director	GOTOH, Sukchiro	2334	sgotoh	
Deputy Director	OI, Ko	2416	koimoon	
Independent Senior Researcher	AOKI, Yoji	2389	yojiaoki	
Environmental Economics Section				
Leader	GOTO, Noriyuki	3401		
	AOYAGI, Midori	2392	aoyagi	
	HIBIKI, Akira	2510	hibiki	
	KAWASHIMA, Yasuko	2430	ykawas	

Resources Management Section			
Leader	OTOMA, Suehiro	2420	otoma
	MORI, Yasuhumi	2539	mori-y
	TERAZONO, Atsushi	2506	terazono
Environmental Planning Section			
Leader	HARASAWA, Hideo	2507	harasawa
	TAKAHASHI, Kiyoshi	2543	ktakaha
Information Processing and Analysis Section			
Leader	TAMURA, Masayuki	2479	m-tamura
	SHIMIZU, Akira	2452	simiaki
	SUGA, Shinsuke	2456	sugas
	YAMAGATA, Yoshiki	2545	yamagata
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Acronyms and Abbreviations

ACC	aminocyclopropane carboxylic acid	NMR	nuclear magnetic resonance spectro(metry)(scopy)
ADEOS	Advanced Earth Observing Satellite	NOAA	National Oceanic and Atmospheric Administration
AIM	Asian-Pacific Integrated Model	OA	ovalbumin
ALA	alanine	OR	odds ratio
APN	Asia-Pacific Network for Global Change Research	O ₂ ^{·-}	superoxide radical
AQC	Analytical Quality Control	PBM	probability-based matching
Asp	Aspartic acid	PCR	polymerase chain reaction
AVG	aminoethoxyvinylglycine	PPFD	photosynthetic photon flux density
CAO	Central Aerological Observatory	RAPD	Random Amplified Polymorphic DNA
CGER	Center for Global Environmental Research	RIS	Retroreflector in Space
cGR	cytosolic glutathione reductase	SESAME	Second European Stratospheric Arctic and Mid-latitude Experiment
CRM	certified reference material	SGM	Second Generation Model
cSOD	cytosolic superoxide dismutase	SOD	superoxide dismutase
DBH	Diameter at Breast Height	START	SysTem for Analysis, Research, and Training
DE	diesel exhaust	TBT	tributyltin compounds
DEP	diesel exhaust particles	Th2	Type2 helper T cell
DNA	deoxyribonucleic acid	TIC	total inorganic carbon
EA	environmental auditing	TPT	triphenyltin compounds
ECP	Eosinophil cationic protein	UNEP	United Nations Environment Programme
EL	environmental labelling	UV-B	ultraviolet-B
ELISA	enzyme-linked immunosorbent assay	WHO	World Health Organization
EMS	environmental management system	WWW	World Wide Web
EPE	environmental performance evaluation	8-OHdG	8-hydroxy deoxyguanosine
EPO	Eosinophil peroxidase		
FID	Flame Ionization Detection		
FRIM	Forest Research Institute Malaysia		
GC	gas chromatograph(y)		
GCM	General Circulation Model		
GEMS	Global Environment Monitoring System		
GEMS/Water	Global Environment Monitoring System/Assessment of Freshwater Quality		
GHGs	greenhouse gases		
Glu	glutamic acid		
GM-CSF	granuloma macrophages-colony stimulating factor		
GR	glutathione reductase		
GRID	Global Resource Information Database		
HPLC	high performance liquid chromatograph(y)		
ICP	inductively coupled plasma		
IC ₅₀	50% inhibition concentration		
IL-5	interleukin-5		
ILAS	Improved Limb Atmospheric Spectrometer		
IPCC	Intergovernmental Panel on Climate Change		
kb	kilo base		
kD	kilo Dalton		
IgE	Immunoglobulin E		
IgG1	Immunoglobulin G1		
LAN	local area network		
LCA	life-cycle assessment		
LC ₅₀	50% lethal concentration		
MBP	Major basic protein		
MeAsp	methylaspartic acid		
Nd:YAG	Neodymium Yttrium Aluminum Garnet		
MIP	microwave induced plasma		
mRNA	messenger RNA		
MS	mass spectro(meter)(metry)		
MW	microwave		
NDSC	Network for the Detection of Stratospheric Change		
NIES	National Institute for Environmental Studies		

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