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NIES Annual Report 1999

National Institute for Environmental Studies

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Foreword

The National Institute for Environmental Studies (NIES) was estabished in 1974 to conduct comprehensive environmental studies in natural, social and human sciences. NIES was re-organized and reinforced in 1990 to address, in response to growing social concern, emerhing environmental problems such as global warming and nature conservation. Currently it is an organization consisting of nine divisions and three centers engaging in either basic researches or project activities.

In 2001, NIES will be transformed into an independent research agency in accordance with the policy ongoing governmental reform. On the one hand, such transformation is expected to grnt the freedom the agency needs in maneuvering itself with efficiency. On the other, the agency will bear a formidable task to keep generating worthy scientific findings in the domain of environment, an externality in relation to the world of market economy.

With growing certainty, environmental researches seem to reveal a fact that one phenomenon takes place interrelatedly with all others: Temperature changes in the equatorial Pacific cause intense climate changes in variots regions across the world; a flood of the Changjiang River causes astonishing changes in marine environment of the japan Sea along the coasts of Russia and North Korea as well as around the japanese archipelago; a food chain generating bioconcentration of environmental pollutants such as mercury and PCBs is no longer a simple chain of predations but forms an extremely complex web extending its hands in numerous directions. Needless to say, human beings are inextricably embedded in the web called the global ecosystem.

Our future seems to depend on how skillfully and effectively we can sustain balancing the interdependent web of the global ecosystem.

大井玄

Gen OHI, MD., D.Sci., M.P.H.
Director General

Contents

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

Since its establishment, NIES has conducted basic studies to reveal the nature of and to provide countermeasures to the so called seven common public nuisances; i.e. air pollution, water pollution, soil contamination, noise, vibration, offensive odor and ground subsidence. Researchers at NIES are of various specialties including physics, chemistry, biology, health sciences, engineering, economics, etc. Interdisciplinary joint studies have been carried out, particularly in project research studies. There are various types of specially designed experimental facilities as well as remote research stations like the Lake Kasumigaura Water Research Station, the Okunikkou Field Monitoring Station and Monitoring Station-Hateruma, and Cape Ochi-ishi.

Recent, rapid, technological progress, structural changes in industries and changes in the styles of our daily lives have added new problems for environmental science to deal with. Moreover, global environmental problems, such as global warming, depletion of the stratospheric ozone layer, acid rain, destruction of tropical rain forests, desertification, etc., have recently given rise to deep concern worldwide. NIES underwent a major reorganization (Fig. 1) on July 1, 1990 to 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.

As of the end of FY 1998, the total number of NIES regular personnel was 270 (Table 1). In FY 1998, NIES invited 344 scientists to carry out the research programs as occasion demanded and also 207 researchers (52 foreigners included) joined NIES's research activities. The total budget of FY 1998 was 11,035 million yen (Table 2).

Table 1
Full Number of Personnel

Research	176	65.2%
Management	46	17.0%
Env. Information Center	19	7.0%
Center for Global Env. Research	10	3.7%
Env. Training Institute	19	7.0%
Total	270	100%

(as of the end of FY1998)

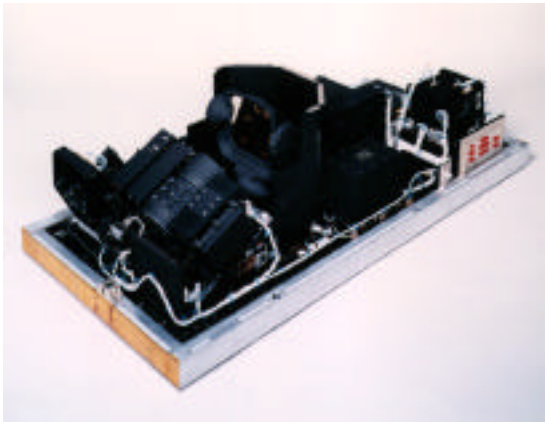
Table 2
Budget in Millions of Yen

Item	FY1996	FY1997	FY1998	
1. Primary budget				(% of total)
Personnel	2,267	2,348	2,348	(26.9%)
Research	694	848	854	(9.8%)
Facilities operations & maintenance	1,418	1,527	1,527	(17.5%)
Info. & related research	509	558	523	(6.0%)
Center for Global Env. Research	2,091	2,356	2,472	(28.3%)
Env. Training Institute	121	109	121	(1.4%)
Administration	356	490	540	(6.2%)
Facilities maintenance and repairs	463	256	348	(3.9%)
Total	7,919	8,492	8,734	(100%)
2. Additional resources from external research funds				
EA Research Funds	1,217	1,482	1,528	
STA Research Funds and etc.	683	537	773	
Total	1,900	2,019	2,301	

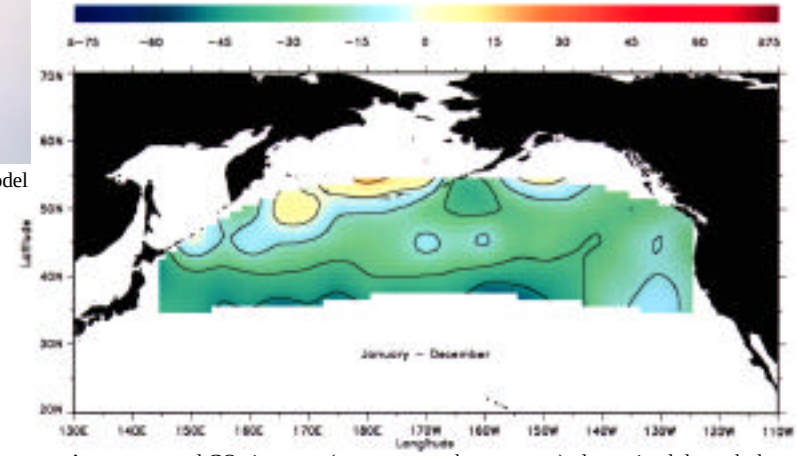
(EA=Environment Agency, STA=Science and Technology Agency)

Fig. 1
Organization of the National Institute for Environmental Studies

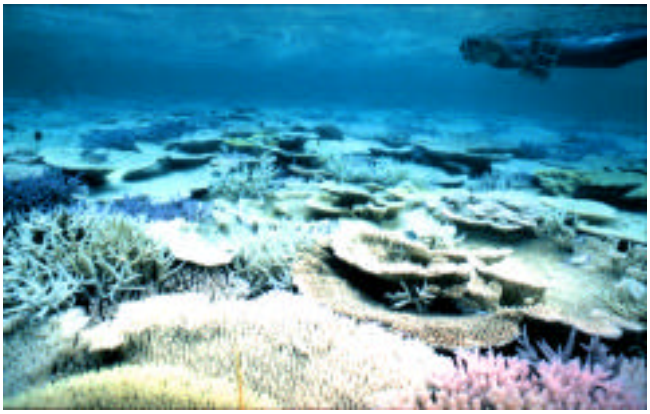
Global Environment Division



Improved Limb Atmospheric Spectrometer (ILAS) flight model (without cover).



Average annual CO_2 increase (ocean-atmosphere,μ atom), determined through the cargo ship monitoring program.



Bleaching of coral at Yaeyama Islands, caused by the unusual rise of water temperature in summer 1998(photo by Yaeyama Marine Park Research Station,Marine Parks Center).

Black-headed bulbul (*Pycnonotus atriceps*) on a fruiting tree in Malaysia.

The mission of the Global Environment Research Division is to investigate contemporary global environmental issues with interdisciplinary and integrated approaches. These approaches are used to analyze, evaluate and understand the issues. Based on the new insights so generated, it is hoped that technical and policy measures to solve environmental problems can be formulated. Here, the activities of the 9 teams in the Division are introduced and 3 major recent research topics are described in depth.

Global Warming Mechanism Research Team

This team is measuring greenhouse gases in the troposphere and hydrosphere, using the NIES monitoring network with various platforms established by CGER/NIES, including ground-based stations, ships-of-opportunity and aircraft. Steadily increasing atmospheric concentrations of CO_2 at the two background air monitoring stations, located at Hateruma Island in Okinawa Prefecture, and at Cape Ochi-ishi in Hokkaido Prefecture, have been observed since 1993 and 1995, respectively. There was a leveling-off in 1997 and a large increase in 1998, which might be related to the recent El Niño phenomenon. Latitudinal distributions of atmospheric CO_2, CH_4 and N_2O have been measured precisely since 1992 from a ship-of-opportunity that sails regularly between Japan and Australia; bottles of marine air are sampled automatically from 25°S to 35°N every 6 weeks. Additional sampling started in 1995 using another ship-of-opportunity that sails regularly between Canada and Japan, collecting samples of the atmosphere between 54°N and 36°N to extend the latitudinal coverage. Air sampling for the measurement of vertical profiles of greenhouse gases has been carried out monthly since 1993 over Surgut, western Siberia, using a chartered aircraft; similar sampling in eastern and central Siberia has begun. Air samples are collected at 8 different heights between 500 and 7000 m. The seasonal cycle of CO_2 concentration at 500 and 7000 m showed maxima in late March and late April and minima in late July and late August, respectively. The results of pCO_2 measurements in surface seawater by the Japan-Canada ship-of-opportunity were analyzed to estimate the CO_2 invasion and evasion flux in the North Pacific. In the western North Pacific, surface pCO_2 was found to increase in winter by deepening of surface mixing and to decrease in summer due to production of phytoplankton. In the mid-latitude Pacific, a small seasonal variation in pCO_2, mainly due to sea surface temperature change, was observed. The high-latitude western North Pacific acts as a net source of CO_2 and the mid-latitude North Pacific is a net sink for atmospheric CO_2. A total CO_2 influx of approximately 0.3 Gt/year in the North Pacific north of 35°N was calculated based on the seasonal pCO_2 measurements.

Global Warming Response Research Team

This team has been developing the Asian-Pacific Integrated Model (AIM) with Kyoto University and collaborating institutes in China, India, Korea and Indonesia. The model is used for assessing policy options toward stabilizing the global climate, particularly in the Asian-Pacific region, with the objectives of reducing greenhouse gas emissions and preventing impact from climate change.

The AIM comprises three main models - a greenhouse gas emission model (AIM/emission), a global climate model (AIM/climate), and a climate-change impact model (AIM/impact). The AIM/emission model has been extended to analyze systematically

the effects of countermeasures and the resulting projected national CO_2 emissions through 2030. The AIM/climate model was improved to formulate a safe emission corridor, that is, an acceptable range of emissions. The AIM/impact model has been linked to an economic model for assessing damage from climate change.

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

Ozone Layer Research Team

The stratospheric ozone layer is indispensable for the survival of life on Earth. Recently, it has been revealed that active chlorine originating from anthropogenic chlorofluorocarbons (CFCs) destroys ozone especially in early spring in the polar regions. Ozone depletion in the mid- and high latitudes of the northern hemisphere was extraordinarily pronounced during the winters of 1994/1995, 1995/1996, and 1996/1997. 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 as well as participating in national and international research campaigns, such as the Third European Stratospheric Experiments on Ozone (THESEO) in cooperation with national institutions and universities, and foreign institutions. The team is also in charge of the ozone layer monitoring effort supported by CGER. Ozone levels at altitudes of 15 to 45 km have been monitored for more than 9 years with a laser radar, as a component of the Network for the Detection of Stratospheric Change (NDSC). In September 1995, a millimeter-wave radiometer was installed to measure vertical profiles of ozone continuously from 35 to 75 km to extend the ozone measurement capabilities in both time and space.

A three-dimensional model including chemistry, radiative transfer and dynamics has been developed to investigate the ozone depletion mechanisms within and around the polar vortices. Laboratory studies of atmospheric trace species were carried out to determine photochemical properties and rates of chemical reactions, including heterogeneous processes.

Satellite Remote Sensing Research Team

The Satellite Remote Sensing Research Team has been taking a leading role in promoting the Improved Limb Atmospheric Spectrometer (ILAS) and ILAS-II projects for monitoring the stratospheric ozone layer from space. The ILAS instrument was in operation on-board the Advanced Earth Observing Satellite (ADEOS) spacecraft from November 1996 to June 1997, when ADEOS lost its functions due to failure of its solar battery. ILAS-II will be launched in 2001 and will have improved capabilities for characterizing stratospheric ozone layer chemistry and polar stratospheric clouds.

The team developed and has been modifying the ILAS data processing software.

The revised software reflects the results of algorithm studies and instrument function evaluation conducted from 1996 through 1998. The ILAS data were processed to provide profiles of ozone and other trace gas species in the high-latitude stratosphere. These profiles were compared with data obtained by ballons and from ground in ILAS validation experiments.

The team takes leadership in managing a group of researchers from Japanese and overseas universities and research institutes who conduct scientific studies related to the ILAS project. The members have been working on revising algorithms for data processing, analysis of validation experiment data, and scientific analysis for the project. Validation analyses indicated that the ILAS instrument worked normally and produced valuable data for studying ozone layer chemistry and polar stratospheric dynamics.

Acid Deposition Research Team

The Acid Deposition Research Team is studying estimates of emissions, transport, deposition, and impact of acidic pollutants on life-environment systems in East Asia, including China, Korea and Japan.

Transboundary air pollution reaching Japan from the Asian continent was investigated through an intensive field survey of air pollutants at a remote island in the East China Sea and a semi-urban sampling site in winter from 27 January to 15 February1998. High concentrations of non-sea-salt-SO_4^{2-} that reached 300 and 350 neq m^{-3} on 2 and 9 February, respectively, were observed in both sampling sites, indicating transboundary air pollution covering more than 200 km with synoptic weather condition.

Coal-biomass briquette technology was improved by introducing a new kind of waste material as a sulfur-fixative. The new coal-biomass briquette ignites better and has higher combustion efficiency. The fixative is also effective for denitrification. A new dry coal-cleaning technology utilizing electrostatic or supersonic techniques was examined as a means of separating coal from pyrite, ash and various unnecessary materials. The new technique was found to have higher separation efficiency than the conventional wet coal-cleaning method.

The aluminum content of lake water and fish organs was investigated in Lake Usoriko (pH 3.6), Lake Inawashiroko (pH 5.0) and the River Tenryu (pH 7.7). The concentration of total soluble aluminum in the water was 0.51 mg l^{-1} in Lake Usoriko, 0.05 mg l^{-1} in Lake Inawashiroko and less than 0.01 mg l^{-1} in the River Tenryu. The chemical forms of soluble aluminum in the acidic water were characterized as Al^{3+}, AlL^{2+} and AlL^{1+}. More than 90% of soluble aluminum in Lake Usoriko water was Al^{3+}, whereas AlL^{2+} was dominant in Lake Inawashiroko water. The aluminum concentration in the organs of *Tribolodou hakonensis* living in Lake Inawashiroko was approximately the same as that in this species in Lake Usoriko, in spite of the differences in water chemistry between the two acidic lakes, especially pH and aluminum content. This suggests that aluminum accumulation might be controlled in fish living in acidic lakes.

Marine Environment Research Team

The coastal and marginal seas adjacent to the Asian Continent are influenced by anthropogenic effects such as the discharge of excess nitrogen, phosphorus and hazardous chemicals. The objectives of the Marine Environment Research Team are to detect deterioration in marine ecosystems and reduce the uncertainties inherent in assessing anthropogenic effects. In order to assess broadly these changes in Asian marginal seas, a program to monitor changes in nutrients and properties of phytoplankton is being carried out using a ship-of-opportunity sailing between Japan and Hong Kong. An NIES (Japan) - State Oceanographic Administration (China) collaborative research program was carried out, consisting of a field survey and in situ experiments in the Changjiang (Yangtze) River estuary, the largest source of discharges to Asian marginal seas. In addition, a solid-phase extractor system was developed and deployed on a ferry to determine in situ concentrations of hazardous trace chemicals. Also, a method to archive underwater stereo images of coral reefs was developed for use in analyzing the growth, deterioration and maintenance of biodiversity in coral reef ecosystems. In particular, the bleaching of corals due possibly to anomalously high water temperatures was recorded in summer 1998.

Natural Vegetation Conservation Research Team

In order to clarify plant and animal interactions in disturbed and non-disturbed parts of a forest, the Natural Vegetation Conservation Team studied, in the Pasoh Forest Reserve (lat 2°58'N, long 102°18'E, in the State of Negeri Sembilan, about 70 km southeast of Kuala Lumpur, Malaysia), canopy structure and gap formation process and their effects on seedling establishment, plant defense mechanisms against herbivores and animal behavior. Canopy structure was found to be dependent on soil and topography, whereas the distribution and size of the canopy gaps were found to be little changed in the period between two censuses in 1995 and 1997, respectively. Mortality and growth of juvenile trees were greatly influenced by the presence of canopy gaps. In addition, the density of insect herbivores and the extent of the damage they caused on seedling growth were greater under gaps than closed canopy, whereas the predators on these insects were more abundant under gaps than closed canopy. Rodents, one of the major seed predators, were inactivated by gap formation, primarily because they try to avoid such open sites where they are easily attacked by their predators. These results suggest that the Pasoh Forest Reserve is in an equilibrium condition in terms of gap formation rate, but that the regeneration process after gap formation is strictly regulated by interaction among tree seedlings, herbivores and predators. If one component of such interaction does not function well, the regeneration process of the forest will be disordered.

Wildlife Conservation Research Team

This team has been studying the effects of habitat fragmentation on population processes in wildlife. Alteration of habitats caused by human activity is the greatest threat to biodiversity. Habitat alteration generally has two components: (1) reduction of the total size of a natural habitat in a landscape, (2) and apportionment of the remaining habitat into smaller, more isolated patches. Although the latter component is fragmentation in a strict sense, both components usually occur in tandem. The effects of fragmentation can be seen at several levels of biological organization from changes in gene frequencies to changes in the geographical distribution of species and ecosystems.

Habitat fragmentation usually decreases the numbers of animals and plants living in each habitat patch. Such decreased populations are assumed to be more vulnerable to extinction than before, because in populations the greater the effects of demographic and environmental variability, the higher the susceptibility to disease. Populations in fragmented habitats may suffer significant genetic deterioration, that is, a decrease in genetic variability, which may lead to a corresponding decrease in fitness (survival and reproduction).

Habitat fragmentation increases edge effects. The outer boundary of any habitat island is not a line, but rather a zone of influence from the outer area. In order to detect edge effects on avian community structure, monthly netting has been conducted in the inner and boundary zone of Pasoh Forest Nature Reserve.

Human Dimensions Research Team

In light of the increasing importance of human dimensions in global environmental issues, this team began, in FY1995, to reorganize the Global Environment Research Program researchers whose interests were related to the Human Dimensions of Global Environment Change Program (HDP). Those interests cover 1) effects of land-use/ cover change on global environmental change (Land Use for Global Environmental Conservation: LU/GEC); 2) international comparisons of public perception, knowledge, behavior and communication related to the environment; 3) human activities and their impact on the environment and socio-economic system; and 4) quality of life and risk assessment. In June 1997, the Second Open Meeting on Human Dimension Research was held at IIASA in Luxembourg, Austria. NIES researchers who conducted HDP research in the institute, participated in this meeting and presented recent results. They also had ample opportunities to communicate with researchers in this field and discuss future collaboration. The 3rd HDP Open Meeting will be held in Shonan Village, Japan, in June 1999. Results of recent research conducted were submitted to the International Scientific Program Committee (ISPC). All the research conducted in the institute is directly or indirectly linked to research projects initiated by the International Human Dimension Program (IHDP). In addition to current research themes, a researcher from this team participated in the international science planning committee for the Industrial Transformation (IT) project, which is also a core project of IHDP. The committee held 8 regional meetings and the research themes proposed at those meetings were finalized at the Open Scientific Meeting in the Netherlands in February 1999. One IT research project on information and communication proposed by the participant from this institute was included as a core project.

Developments in the CCSR/NIES chemistry-coupled general circulation model (GCM), the nudging chemical transport model(CTM), and the chemical-trajectory model

The ozone hole over Antarctica has been growing, and decreases in ozone levels in Arctic regions and mid-latitudes have also been found recently. Since ozone destruction mechanisms are very complicated due to interaction processes between transport, photochemistry, and radiation, a simple local model is inadequate for understanding these mechanisms. Recent computer developments have enabled us to calculate three-dimensional fields and variations in chemical species by three-

dimensional chemical models. Global data on chemical constituents have also been accumulated from satellite observations and global ground-based observation networks. These global data have made it possible to validate three-dimensional global chemical models. Global simulation of ozone depletion, understanding the depletion mechanisms, and future ozone prediction using such models are very necessary.

A chemistry-coupled general circulation model (GCM) was developed in order to understand ozone depletion mechanisms within and around the polar vortices. The chemical scheme and the chemical-radiative coupling scheme of the one-dimensional chemical-radiative coupled model that was developed in NIES was modified for the three-dimensional model and incorporated into the Center for Climate System Research, University of Tokyo (CCSR)/NIES Atmospheric General Circulation Model (AGCM). Gas phase reactions of O_x, HO_x, NO_x and ClO_x, and several heterogeneous reactions in nitric acid trihydrate (NAT) and ice polar stratospheric clouds (PSCs) have been successfully incorporated with some improvements to the model on horizontal resolution and on oxygen molecule photolysis in the Schumann-Runge bands.

Heterogeneous reactions in the NAT PSCs and the ice PSCs were incorporated in the GCM. The degree of supersaturation of nitric acid gas and water vapor over these PSCs was calculated, and assumed to make the PSCs. The PSCs evaporated when the partial pressures of nitric acid gas and water vapor were under saturated. The radius of the NAT PSCs was assumed to be 1 μm, and that of the ice PSCs was 10 micrometers. The sedimentation process of these particles by gravity was also considered. The PSCs appeared in the model over Antarctica in the winter and spring, and reduced the total ozone amount to less than 240 DU, as shown in Figure 1. The Arctic ozone decrease was simulated over northeastern Greenland and over the northern Scandinavian peninsula, as shown in Figure 2.

Discrepancies in temperature and winds between the GCM and observations prevent

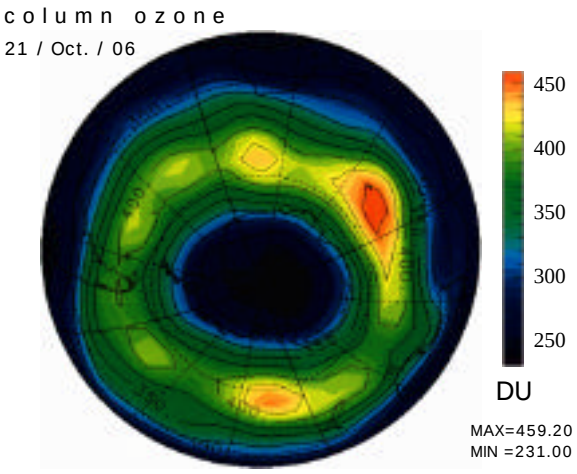


Fig. 1
Total ozone distribution in the southern hemisphere in October, calculated by the CCSR/NIES chemistry-coupled GCM.

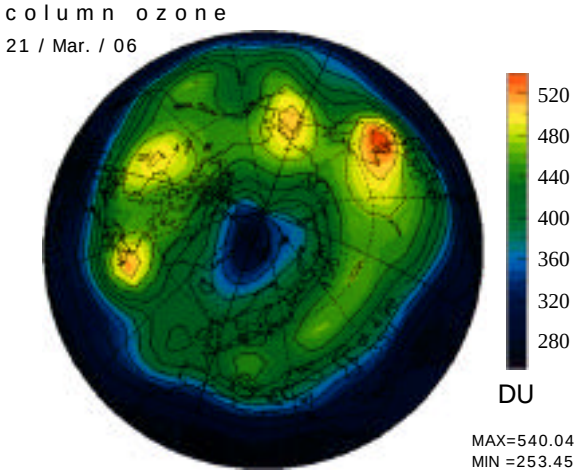


Fig. 2
Total ozone distribution in the northern hemisphere in March, calculated as in Fig. 1.

understanding the photochemical processes in the atmosphere, because chemical processes in the atmosphere are sensitive to temperature, and because transport by winds is important for chemical constituent distribution. A cooling bias of temperature in the GCM has not been solved yet. For this reason, chemical transport model CTM, in which meteorological data are input and chemical processes calculated from input data, is necessary.

The CTM being developed is a nudging CTM based on the GCM, but different from so-called CTMs in which meteorological input data are directly used for chemical calculation. The nudging CTM assimilates input wind and temperature data into the model values with a time constant. A time constant of 1 day was chosen to prevent artificial oscillations due to rapid change in values resulting from data input, and to make the model values closer to observed values. The nudging CTM improved the temperature and zonal wind distributions greatly. For example, the minimum temperature over the Antarctic in July was about 180 K, while colder than 170 K in the GCM. Thus, the maximum zonal westerly wind was suppressed to about 100 m s^{-1}, while over 170 m s^{-1} in the GCM. Seasonal variation in total ozone was also improved using the CTM, particularly in the tropics and Antarctic regions.

The new trajectory model was used for the Arctic region in a domain-filling calculation technique to supplement the coarse horizontal resolution of the three-dimensional models. The technique is to make a horizontal map of chemical constituent concentration on a specified potential temperature surface by calculating photochemistry and advection in many individual air parcels, and mapping the concentrations of all the air parcels on the surface. Figure 3 shows $ClONO_2$ distribution in the Arctic region on 10 March 1997 by this method. Chemical calculations of backward trajectories on 1632 air parcels were made for 11 days. The high-concentration region surrounding the Arctic polar vortex was well simulated, and showed the advantage of this method for simulating the fine spatial structure of $ClONO_2$.

Efforts for further development of the chemistry-coupled GCM, the nudging CTM and the trajectory model are being made with more sophisticated chemistry schemes

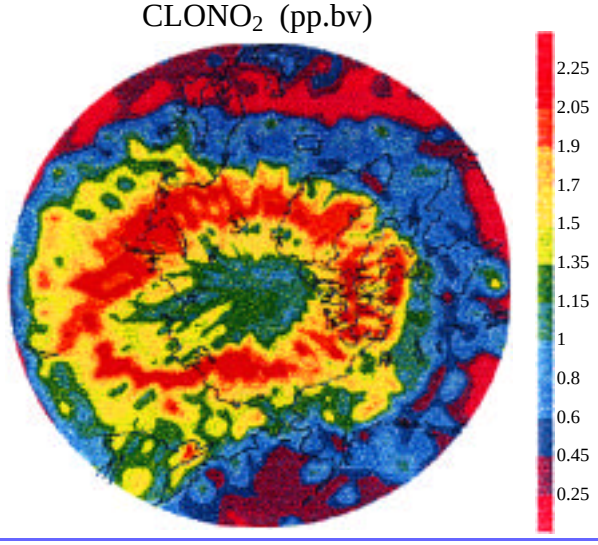


Fig. 3
Polar stereographic projection of the distribution of $ClONO_2$ volume mixing ratios between 50˚N and 90˚N on the 480 K potential temperature surface (altitude about 20 km) on 10 March 1997, calculated by the domain-filling trajectory technique.

and with higher spatial resolutions. Numerical experiments and simulations by these models will lead to better understanding of ozone depletion.

Local Variation of Canopy Structure in Relation to Soils and Topography and the Implications for Species Diversity in a Rainforest in Peninsular Malaysia

It is widely known that tropical forests consist of several superposed strata. Unlogged lowland dipterocarp forest in Southeast Asia usually forms distinct multiple stories, with emergent, canopy, understory, and shrub layers. Canopy trees with heights of more than 30 to 40 m form a dense complete layer under the emergent layer. Such complexity in vertical structure is believed to provide a wide range of micro-environments and thus more types of habitats than in forests with simpler layer structures.

Many factors influence the complex structure of the rain forest. Two obvious factors are topography and drainage regime, which interact and have additional effects on soil development. Under mesic conditions, roots are shallow and trees tend to be toppled by windstorms, whereas trees usually die standing or are snapped off under xeric conditions, because their roots are deep. Thus, differences in soil conditions that relate to topography may influence the gap size and recovery processes in tree communities.

As the canopy gaps close and the forest structure becomes re-established, segregation of species occurs based on their physiological response to the changing light environment, and species diversity is expected to decrease, although the forest structure has become more complex. As a result of interactions among these environmental factors, species diversity is expected to vary throughout the process of forest structure development. Is then species diversity related to canopy structure or relatively stable as a result of habitat specialization of species adapted to micro-environments based on differences in soils and topography? To answer this question the relationship between diversity, canopy height, soil and topography of local tree species was examined using digital elevation models of the canopy surface and data from a tree demographic census in a lowland dipterocarp forest in Peninsular Malaysia.

The study was conducted in the 50 ha plot within the Pasoh Forest Reserve. The topography type within each section of 10 m-square grid (sub-plot) was categorized into one of six groups; ridgetop (TOP), higher slope (HIGH), mid-slope (MID), lower slope (LOW), flatland (FLT), and valley (VAL), based on the slope ratio and index of convexity within each sub-plot. The soil series were classified into 4 major groups based on their parent materials: those that developed on shale (Group 1: BGR), those whose parent materials were lateritic soils (Group 2: TRP, GMI), moderately well-drained to well-drained soils that developed in riverine alluvium (Group 3: TWR, TBK), and soils that developed on riverine alluvium with imperfect to somewhat imperfect drainage (Group 4: AMA, AWG, KPU). The hilly parts of the plot were mostly covered by soils of Groups 1 and 2, whereas flat, alluvial or riverine areas were mostly covered by soils of Groups 3 and 4. A digital elevation model (DEM) of the canopy surface was made, based upon aerial photographs at a scale of 1/6000

taken over the Reserve plot. Data were digitized using a grid pattern with 2.5 m intervals. Canopy height was then obtained by subtracting the ground elevation height from DEM readings at 2.5 m intervals.

The tree demography data obtained in the 50 ha plot were subdivided into 5000 sub-plots (10 x 10 m in size), and the numbers of species and trees were counted within each sub-plot. Canopy height, soil and topography data sets were all interpolated into each of these sub-plots. The highest point in the canopy surface within each sub-plot was then obtained based on the DEM data for canopy height. "Canopy height" hereafter refers to the highest point in each sub-plot. In order to analyze the variation in local species diversity in relation to canopy height, Fisher's α was calculated for each sub-plot.

Variation of canopy height with respect to topography and soil type

The average canopy height in the plot was 34.7 m, with a range of 11.6 to 60.9 m, and varied with respect to the defined topography classes (Fig. 4). Canopy height in the riverine topography (VAL) was significantly lower than in any other type of topography except TOP. Canopy height was lower in FLT topography than in hilly topography (LOW, MID, HIGH), but the difference in the canopy height between FLT and VAL was not significant. Therefore, it appears that canopy height was generally higher in upland parts of the study area than in flat alluvial or riverine areas, with the exception of ridgetop (TOP) areas. However, the differences in average canopy height among the 6 topography types were 2 to 2.5 m at most.

Canopy height also depended on soil type. Heights were generally lower on soils with poor drainage that had developed in alluvial or riverine areas (Group 4: AWG, AMA and KPU) than on well drained soils that had developed from shale (Group 1: BGR) or lateritic (Group 2: GMI, TRP) parent materials that covered the slopes (LOW, MID and HIGH). The canopy in plots with moderately well or well-drained soil types (Group 3: TBK, TWR) was significantly higher than in the other soil types that developed in alluvial areas and this suggests that drainage is a key determinant of canopy height even for soils that developed in flat alluvial areas. Differences in soil

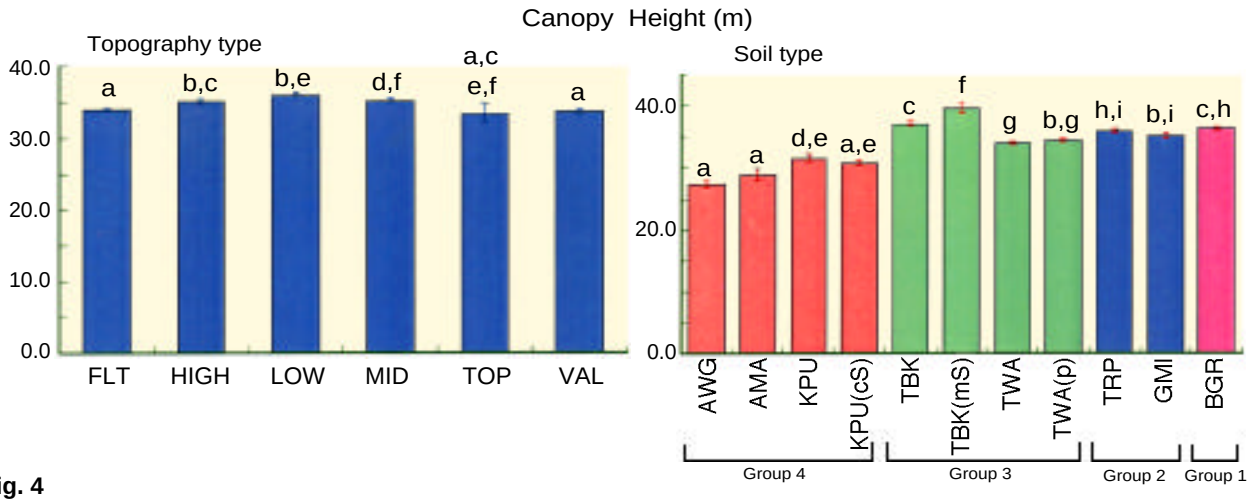


Fig. 4
Variation in canopy height (m) as a function of topography and soil type. Bars labeled with different characters are significantly different (P >0.01). Vertical bars represent ± 1 SE (standard error).

type caused larger differences in canopy height than did topography. For example, the canopy height for soil type AWG was 27 m, whereas that for the TBK soil type was almost 40 m.

Variation in species diversity with respect to canopy height, topography and soil type

Fisher's α for the whole study area showed no significant relationship with canopy height. Even regression analyses conducted within each type of topography and soil type were generally not significant. In contrast with its relationship with canopy height, the value of Fisher's α was influenced by differences in topography and soil type. Fisher's α value was higher in the upland areas (hill slopes and ridgetop) than in the FLT areas, while the species diversity in TOP topography type was significantly higher than in all other topography types. Fisher's α was higher for the TRP and BGR soil types which were distributed primarily on slopes, than for any other type of soils. For the GMI soil type, which includes the TOP topography type, Fisher's α was not significantly different from that of the other soil types. In contrast, Fisher's α value was lowest in the TWR soil type which develops in flat alluvial areas.

The results of the present study demonstrated that local species diversity (as expressed by Fisher's α value) was not strongly influenced by variations in canopy height. The result implies that if canopy height increases as the forest structure develops after gap formation, species segregation during the rebuilding phase does not occur as expected; that is, some species are specially adapted to the gap environment, and thus their dominance decreases as the forest structure matures. However, some species newly recruited during the process of canopy structure development are adapted to the understory environment beneath a semi-dense or fully dense canopy.

Two other possible explanations may account for the indistinct relationship between canopy height and species diversity. First, even though the canopy height in some subplots was evaluated as being very low based on the present photogrammetric DEM maps, some of the area is covered by "old gaps". These gaps now have a dense canopy that includes numerous vines. Regeneration by tree seedlings and saplings beneath such a canopy is difficult because only some species are adapted to the low light intensity in that environment. The second explanation is that seed sources may have been limited in the study area because of a relative lack of pioneer species (which normally produce dormant buried seeds that regenerate only in gaps) or irregular and sporadic fruiting (e.g. masting) by the canopy-forming species. For these reasons, a dramatic increase in species abundance cannot always be expected after gap-forming events.

The present study could not provide conclusive evidence for whether niche separation among the species was determined by soil or topography types, but nonetheless demonstrated the possibility of species composition changes along these two environmental gradients at a local scale. Further analysis of recruitment, mortality and regrowth of trees as a function of soil type and topography must be conducted to resolve this problem.

Fluctuating asymmetry of the oriental fruit fly (*Dacus dorsalis*) during the process of its extinction from the Okinawa Islands

Fluctuating asymmetry (FA), small random deviations between the left and right sides of normally bilaterally symmetrical characters, has been suggested as a measure of developmental stability in stressed populations because it increases with decreasing genetic variation and increasing environmental stress. For this reason, conservation biologists see FA as a useful index to assess the status of endangered species; indeed, small populations show higher FA than larger local populations of the same species.

The eradication of the oriental fruit fly *Dacus dorsalis* from the Okinawa Islands of Japan provides one such data set. *D. dorsalis* spread rapidly after its introduction in 1919, reaching Amami Island, some 200 km north, by 1929. Eradication of the population on the main island of Okinawa started in 1977, through helicopter and manual distribution of materials such as rope and fiberboard impregnated with a lure-toxicant methyl eugenol, and was complete by 1982. Trapping (with methyl eugenol) was conducted twice monthly to evaluate the control program and the trapped flies were preserved as dry specimens by the Okinawa Prefectural Fruit Fly Eradication Project. For the measurement of FA, only flies trapped within Naha City were used, to avoid the possible effects of heterogeneity between localities. Fifty male flies were randomly chosen from individuals trapped each month from February 1977 to September 1979. It was not usually possible to collect 50 flies in the winter months (February to April). After October 1979 a few individuals were trapped for the next three months, then none were trapped. Both wings were removed from the thorax, mounted on glass slides and photographed using a video camera fitted to a microscope. Two different veins were measured (Fig. 5) using an image analysis program accurate to 1 μm.

The number of flies trapped in Naha City in each month is shown in Fig. 5(a). Before the effects of eradication program (before October 1977), the fly showed seasonal changes in numbers: it tended to be abundant during summer (May to September) and less abundant in winter (February to April). After the eradication program started, the population density in summer leveled off and the flies had almost disappeared by October 1980. As no individuals were trapped through summer 1981, the fly may

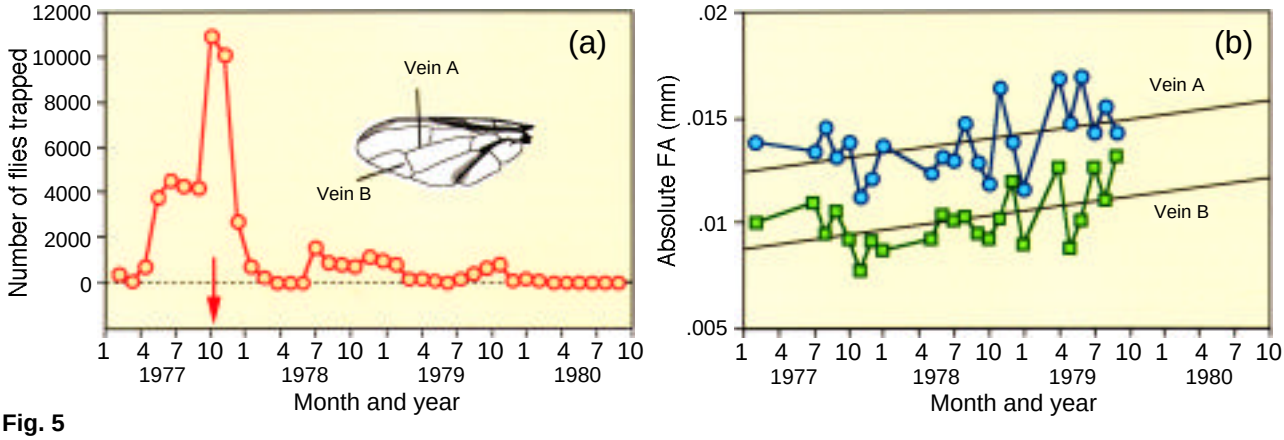


Fig. 5
Vein length measurements made on the oriental fruit fly, *Dacus dorsalis*. Temporal changes in the numbers of fruit flies trapped in Naha City (a), and accompanying change in FA of veins A and B of fruit fly wings (b). Arrow indicates the time when the eradication program started.

have been almost extinct then. Monthly trapping efforts continued until 1982, when it was confirmed that the species was completely extinct from the main island of Okinawa.

Temporal changes in the mean FA of veins A and B are shown in Fig. 5(b). FA in both characters increased as the eradication program progressed. As FA varied substantially between months it is difficult to see the precise pattern of its temporal change; however, it seems that there were differences in levels of FA between years. The greatest increase in FA in these characters occurred in the year immediately before the probable year of the fly's extinction.

Extinction is the final result in a population suffering serious environmental and/or genetic stress. The usefulness of FA to detect stress is controversial but this study is the first to demonstrate an increase in FA during the extinction of a population, which strongly suggests that FA is a useful indicator of stress. It is not known whether the increase in FA in the nearly extinct population was caused by reduced genetic variation, or stress from the toxicant used in the eradication program. However, reduced genetic variation is the more likely explanation because no apparent increase was observed in 1978, a year after the program began. As the lure-toxicant attracts only male flies, it is almost impossible for it to influence the FA of the next generation.

Edge effects on avian community structure in a lowland rainforest in Peninsular Malaysia

Tropical lowland rainforests have drastically decreased and become fragmented in the last few decades in Peninsular Malaysia. This has caused habitat fragmentation, in which the edge area increases relative to the size of the inner area. The fragmented habitats may be subject to higher risk of predation by omnivorous predators, which usually inhabit the edge of the forests.

Surrounded by oil palm plantations, Pasoh Forest Reserve is a small isolated forest area, the inner areas of which remains virgin forest. In order to detect edge effects on the avian community in the Pasoh Reserve, monthly netting has been carried out in the inner area since 1992 and at the boundaries since 1996.

In total, mist-net operations were carried out for 4319 net-days. There were 93 species totaling 1168 birds captured during the study period. Every captured bird was measured, banded with an individually numbered aluminum ring, and released outside the net site where it was trapped. The abundance of understory birds was not different between the study plots. However, species diversity was lower around the forest edge than in the inner area. The insectivorous ground foragers such as babblers Timaliidae and pittas Pittidae decreased in numbers from the inner area toward the boundary of the rainforest. In contrast, the numbers of nectarivores and frugivores such as sunbirds Nectarinidae and bulbuls Pycnonotidae increased at the boundary.

It is assumed that if edge effects occur, predation pressure would be higher in the peripheral than in the inner area of the forest. To evaluate predation pressure, 862 experimental nests, each with a few quail Coturnix japonica eggs, were placed in the

Fig. 6
Long-tailed giant rat, *Leopoldamys sabanus*, one of the commonest nest predators in the Pasoh Forest Reserve.

understory of the forest. A pair of nests was set near each netting site, and monitored for 4 days. An automatically triggered camera was placed near one of each pair of nests to confirm the identity of the predators. The proportion of experimental nests that was depredated, i.e. the extent of predation pressure, was found to be higher near the forest edge than in the inner area. The camera revealed that the predominant predators were pig-tailed macaque, long-tailed giant rat and short-tailed mongoose(Fig. 6).

In summary, the diversity of bird species in Pasoh Reserve declines gradually from the inner area toward the boundary of the forest, because predation pressure on the birds, which build their nests close to the ground, increases toward the forest edge (Fig. 7). This might be a reason why ground foragers like babblers decrease in numbers from the inner area to the boundary of the reserve.

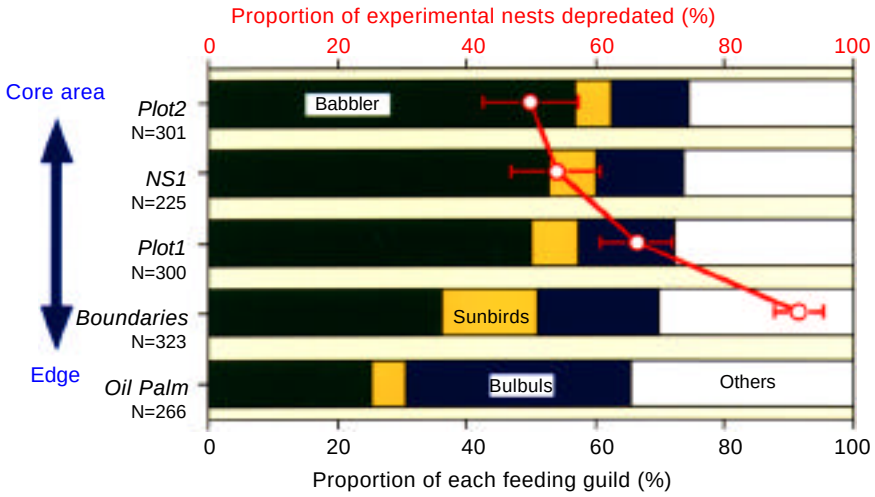


Fig. 7
Changes in avian community structure and predation pressure from the core to the edge of the rainforest. Horizontal red lines show 95% confident intervals of predation rate.

Regional Environment Division

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

Traffic Pollution Control Research Team

This team mainly studies 1) methodology for environmental impact assessment of traffic systems, in particular motor vehicles; and 2) technology assessment of environmentally advanced transport systems, in particular electric vehicles.

Motor vehicles emit various organic compounds, which have been measured as total hydrocarbons and/or non-methane hydrocarbons, as well as NO_x, CO, etc. In recent years, some volatile organic compounds (VOCs) have been regulated as a result of their effects on health; thus, chemical analysis of organic matter emitted by vehicles is required. Studies have been carried out by this team on detailed evaluation of traffic as an emission source of VOCs. On-road real emission factors, which include tail-pipe emission, fuel evaporation, and emission from new and old vehicles, have been determined through tunnel studies. Road traffic census data have been matched to a digital road map for GIS-based calculation of VOC emission distribution. Systems for estimating detailed traffic composition, fuel evaporation, etc. have also been designed in order to improve the GIS-based calculations.

A continuous monitoring method for VOCs has been developed and will provide detailed accurate data on pollution by traffic. A laboratory-constructed system based on an automatic air sampler and a gas chromatograph/mass spectrometer(GC/MS) has been evaluated and improved through field tests. About 20 hazardous air pollutants were detected from ambient air at sub-ppb and at ppb levels.

Studies on electric vehicles and future transportation systems have been carried out as part of a project entitled "Studies on alternatives of urban transportation systems". An on-board electrical-performance monitoring system for electric and hybrid vehicles, including a detailed battery-monitoring system, has been developed and evaluated with a chassis dynamometer through driving tests of a compact electric vehicle, the "Eco-Vehicle" developed in 1996. For the selection of desirable future transportation systems in urban areas, various possible technologies have been evaluated from the viewpoint of life-cycle assessment.

Urban Air Quality Research Team

The major objectives of this research team are to investigate the mechanisms of urban air pollution formation in order to understand the relationship between changes in the relative importance of various air pollution sources and the spatial and temporal

patterns of urban air pollution. The team's program for FY1998 to 2000 comprises 5 research activities, mainly focusing on source characterization of VOCs.

(1) An air pollution emission survey based on field measurements and inventory analysis. In FY1998, a survey commenced of VOC emission from mobile and fixed sources based on inventory analysis, in cooperation with the Traffic Pollution Control Research Team. Preliminary results showed that mobile source emissions constitute approximately 22% of total anthropogenic VOC emissions. This includes evaporative, idling and cold-start emissions. Using tunnel data, emission factors were determined in the real world situation. The estimated emission factors were higher than those obtained from laboratory tests by chassis dynamometer.

(2) Air pollution trend analysis related to changes in pollution loading from various sources. Air pollution trend analysis suggested a change in the mechanism of photochemical ozone formation in summer in both the Kanto and Kansai areas. Recently, regional photochemical ozone maxima have been observed outside the central Kanto and Kansai areas. This trend of spreading concentration maxima of urban oxidants might be a reflection of increasing NO_x emissions and a decreasing ratio of the concentrations of VOCs and NO_x, indicating an increase in ozone formation potential and a decrease in photochemical reactivity, respectively. To understand this phenomenon, a series of model application studies has been conducted.

(3) Wind-tunnel studies of the dynamic behavior of urban air pollution. Thermally stratified wind-tunnel studies, mainly focusing on air pollutant distribution in the street canyon, were conducted to understand the dynamic behavior of urban air pollution. In FY1998, a practical model for predicting air pollution concentration in different degrees of atmospheric stability and different street dimensions was developed. The model results agreed well with wind-tunnel observations. The results are useful for determining the optimum site for an air pollution monitoring station, particularly for investigating the concentrations of hazardous VOCs from automobiles.

(4) Field studies of air pollution and meteorology including observations from aircraft. A VOC monitoring system was established. In FY1998, continuous monitoring was conducted in Saitama Prefecture and Mexico City and observed data were compared. It was found that the VOC concentration level in Mexico City was much higher than that of Saitama Prefecture; in particular, propane and butane concentrations were 10 to 30 times higher in Mexico City than in Saitama Prefecture. This might be caused by leakage of LPG in Mexico City. Such observations are important for clarifying the mechanisms of formation of the serious photochemical air pollution in the Mexico City area.

(5) Studies on an air pollution simulation model and its application to urban areas. Air pollution trend analysis showed that annual average concentrations of ozone are increasing over a wide area of Japan by approximately 1 ppb each year. To learn the reason for this increase, an application study of Models-3/CMAQ (Community Multi-scale Air Quality) was initiated with the US EPA National Exposure Research

Laboratory in 1998. Preliminary field observations for model validation started in FY1998 in cooperation with the Japan Clean Air Program.

Coastal Environment Research Team

The coastal zone, especially in the enclosed-sea areas of Japan, is under real pressure from the consequences of human activities, such as eutrophication, pollution and overcrowding, as well as under potential pressure from proposed developments. Shallow areas have been reclaimed without appropriate consideration of marine ecosystems. The Coastal Environment Research Team aims to develop a precise scientific method to evaluate the vulnerability of the ecosystems of shallow areas through a special research project entitled Studies on Biogeochemical Cycles and Self-purification in Shallow Coastal Areas for Preservation of the Marine Environment.

As a part of the project, field surveys have been conducted in a shallow area, Sanban-se, at the head of Tokyo Bay, monitoring water quality, phytoplankton, and macro- and meiobenthos. Macrobenthic organisms were abundant in the shallow area in all seasons. Bivalves were the dominant animals, accounting for more than 98% of the total biomass; dominant species were *Ruditapes philippinarum*, *Mactra quadrangularis*, and *M. chinensis* (Fig. 1). Respiration rates of bivalves were measured at various temperatures and shown to be faster at higher temperatures, between 15 and 25˚C, and in smaller organisms. Bivalve filter feeders can clear water columns in shallow areas. Habitats with high bivalve biomass, such as the shallow area investigated, can clear large volumes of water faster than the turnover rate of the water mass. Using the static chamber method, the filtration rate of *M. quadrangularis* was found to be 1.0 L g^{-1} h^{-1} (bivalve mass in dry weight of soft body) at 20˚C, and the nitrogen assimilation rate was about 70%. The high clearance and assimilation rates of the bivalves demonstrate the important role of bivalves in biogeochemical cycles in shallow areas.

Copepods have long been believed to consume most of the primary production in coastal areas. However, field observations and experiments in the Seto Inland Sea conducted in the first two years of the project indicated that a significant part of the primary production was channeled into small heterotrophic dinoflagellates (20 to 100 μm in length), appendicularians and doliolids. These organisms play important

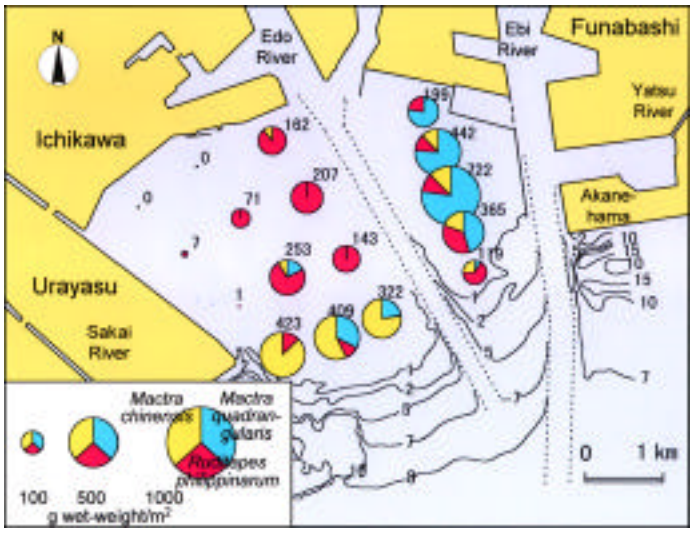


Fig. 1
Distribution pattern of bivalves in a shallow area, Sanban-se, at the head of Tokyo Bay, observed on 13 June 1998.

roles in carbon cycling. In FY1998, the ecological roles of *Noctiluca scintillans*, a large heterotrophic dinoflagellate (0.5 mm in length), which is strongly bioluminescent and forms conspicuous red tides, were also assessed. *N. scintillans* blooms followed those of diatoms and this dinoflagellate was as productive as were the copepods. Knowledge of the ecological roles of these organisms is very important for understanding carbon flow and for protection of coastal ecosystems.

Lake Conservation Research Team

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

The objectives of the project were to develop a method by which DOC is separated into well-characterized macro-fractions, in order to examine the physico-chemical characteristics and dynamics of DOC in Lake Kasumigaura, the second largest lake in Japan; and to evaluate the effects of DOC on the growth of phytoplankton in the lake, and on lake-water quality as a drinking-water source.

The major findings in Lake Kasumigaura in FY1998 were as follows: (1) hydrophilic acids were predominant over aquatic humic substances (AHS) as recalcitrant DOC defined as the DOC remaining after a 100-day aerobic incubation; and (2) hydrophilic fractions (= hydrophilic acids + bases + neutrals) were significantly greater in THM formation potential per mg DOC than were AHS, which have been considered the major THM precursors in natural waters (Fig. 2). These findings suggest that hydrophilic acids are more important than AHS in terms of both recalcitrant DOC and THM precursors in lake waters.

Hazardous Waste Research Team

This team has undertaken experiments on the elution mechanism of hazardous chemical compounds from small-scale landfills as model wastes, and on development of a monitoring methodology for toxicity.

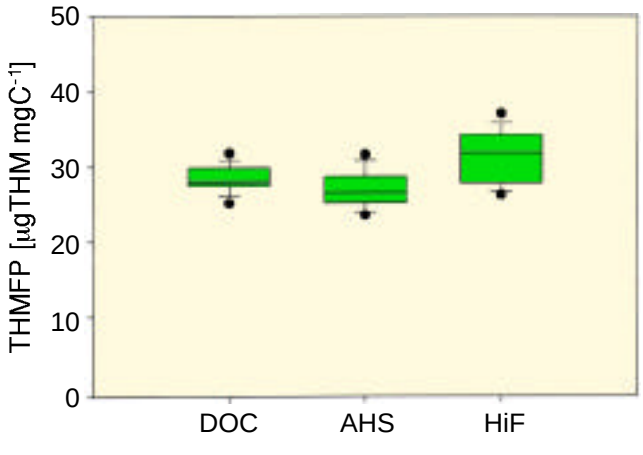


Fig. 2
Trihalomethane formation potential of lake-water filtrate (DOC), aquatic humic substances (AHS) and hydrophilic fractions (HiF) at a sampling site in Lake Kasumigaura near the intake point of a water treatment plant.

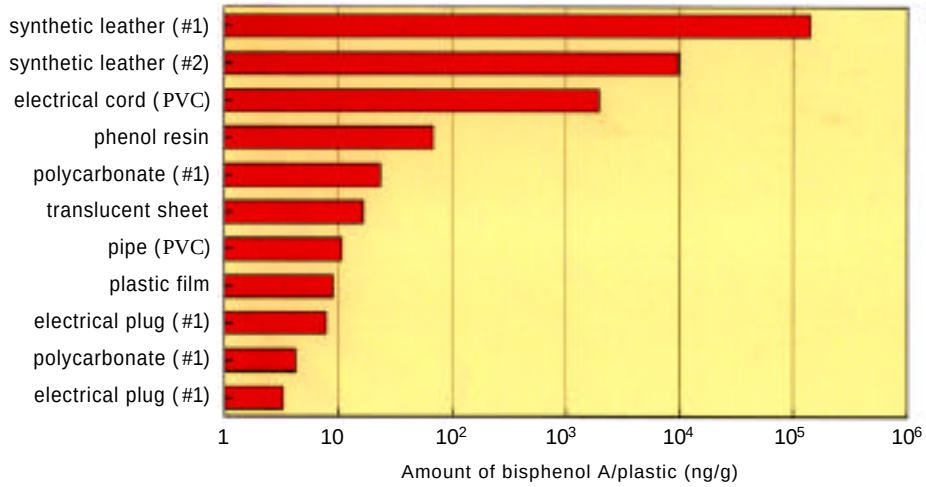


Fig. 3
Levels of bisphenol A leached from various plastic wastes.

According to previous investigations, the main compounds frequently detected at high concentrations in landfill leachates are phosphate esters, bisphenol A, 1,4-dioxane and boron. The origin of phosphate esters and bisphenol A is presumed to be waste plastics. The concentration of bisphenol A leached into water from plastic wastes was determined by GC/MS (Fig. 3). A soft poly (vinyl chloride) product, such as the insulation on electric wire, yielded a high concentration of bisphenol A: 1.98 μg g^{-1}. Several types of waste plastic such as synthetic leather also yielded high concentrations of bisphenol A: 139 μg g^{-1}. These results are reasonable because bisphenol A is used as an additive in plastics. The concentrations of bisphenol A leached from polycarbonate products were very low, although polycarbonate itself contained several μg g^{-1} of bisphenol A as a residual monomer.

Boron levels in landfill leachates, in rain water and in effluent from leachate treatment systems were determined by inductively coupled plasma-mass spectrometry (ICP-MS). The boron concentrations in leachates and rain water were 0.63 to 4.4 mg l^{-1} and 0.2 to 5.3 μg l^{-1}, respectively. The Japanese environmental regulation level of boron concentration is 1.0 mg l^{-1}; boron concentration in several leachates exceeds this regulation level. The origin of the high concentration boron in the leachates was examined by multiple regression analysis. The results suggested that boron is associated with ash from incinerators. Leaching tests for many kinds of wastes showed that several kinds of ash yielded effluents with a high concentration of boron: 2.2 mg l^{-1}. The amount of boron leached from plastics and other material was very low. Judging from these results, the main origin of boron in landfill leachates is ash from incinerators.

Interdisciplinary Impact Assessment Research Project

The Water Quality Renovation Technology Research Team previously studied the contamination of soil and groundwater by hazardous chemicals. Since FY1996, the team has filled the role of an ad-hoc project team to manage a new interdisciplinary area, entitled Life-cycle Assessment (LCA) of Environmental Burdens and Impact Originating from Transportation and Waste Management Systems. This study aims to develop comprehensive environmental impact assessment methodology from the life-cycle point of view. The study focuses on two areas of concern: fundamental methodologies for so-called life-cycle impact assessment (LCIA) and the application of such methodologies to case studies of transportation and waste management systems.

The objects of assessment are systems, including products, services and infrastructure, as well as institutional arrangements, rather than single products or service units. For example, assessments are applied to road transportation systems rather than motor vehicles, and to a recycling system rather than recyclable cans and bottles.

FY1998 was the last year of this 3-year project. The third workshop on Comparative Risk Assessment (CRA) was held with participation of experts and citizens, to measure the relative priority of 6 environmental problem areas and 4 endpoints based on the judgement of the participants. A computer system consisting of an emission inventory model, a fate-prediction model and an exposure assessment model was developed based on geographical information systems (GIS) software in order to assess the spatial distribution of health risks from conventional and hazardous air pollutants at the prefectural level. A case study using this system was conducted for the health risk assessment of benzene. A simple exposure assessment model was also proposed to reflect site-specific conditions of emission sources and surrounding populations with regard to LCIA.

In addition to these methodological studies on impact assessment, case studies of life-cycle inventories (LCIs) were carried out. An LCI of air emissions including CO_2, N_2O, NO_x, SO_2, and non-methane hydrocarbons (NMHCs) was compiled for the production and usage stages of a typical gasoline-engine vehicle. Tail-pipe exhaust gas was a dominant contributor of CO_2 emissions in the life cycle, and other processes produced significant emissions of the other gases. As another case study, an LCI of drink containers was conducted to quantify possible reductions in environmental burden by promotion of their recycling.

Air Pollutants Health Effects Research Team

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

In FY1998, special program began on the effects of PM 2.5 (particulate matter smaller than 2.5 μm such as DEP) on the pulmo-circulatory system. Sub-themes include the following topics: 1) electrophysiological study on the effects of PM 2.5 on pulmonary and circulatory function; 2) pathological analysis of the vascular system; 3) pharmacological analysis of the toxicity and toxic dose in the vascular system of PM 2.5 chemical compounds; 4) biochemical analysis of cardiac cells and blood endothelial cells exposed to PM 2.5 *in vitro*; 5) immunological analysis of tissue and cell damage; and 6) evaluation of the overall risk to human health from exposure to PM 2.5.

DEP, intravenously injected into rats, spontaneously decreased their blood pressure level in a dose-dependent fashion. There was a significant relationship between the control and treatment groups at more than 50 mg kg^{-1} ml^{-1}. Levels of DEP higher than 50 mg kg^{-1} ml^{-1} resulted in abnormal electrocardiograms (ECGs) due to, e.g. A-V block and ventricular extra contraction. These abnormal ECG events disappeared after pharmacological blocking of the autonomic nervous system.

Histo-pathological analysis showed the presence of DEP in the lungs, small arteries and veins, and contraction of blood smooth musclesof intravenously injected guinea pigs. However, acute exposure to DEP did not affect arterial endothelial cells in the guinea pigs.

These results clearly suggest toxic effects on the pulmonary and cardiovascular systems by exposure to DEP; more detailed research is needed.

Chemical Exposure and Health Effects Research Team

This team is in charge of the special research project entitled Reproductive and Developmental Effects of Hormone-like Chemicals in the Environment, which began in FY1997. The aim is to obtain basic data for risk assessment of the effects of endocrine-disrupting chemicals on reproduction and development. Dioxin was selected as a model chemical because the toxicity of dioxin is very strong and the exposure level of the general population to dioxin in Japan is relatively high.

In FY1998, the effects on development of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) on male rat offspring were investigated. Pregnant Holtzman rats were administered a single oral dose of 12.5, 50, 200 or 800 ng TCDD per kg body weight on day 15 of gestation. Offspring were sacrificed 2, 49, 63 and 120 days after birth to investigate the effects of TCDD on the reproductive, endocrine and immune systems.

No TCDD effect was observed in litter size, birth weight or sex ratio of offspring. The highest maternal dose of TCDD caused an increase in liver weight (15.3%) as well as significant thymic atrophy (20.1%) on day 63 but not on days 49 or 120. A significant decrease in serum T4 levels (14.7%) was induced at the highest dose of TCDD on day 63, but not on days 49 or 120. Serum T3 and TSH levels in the offspring were not affected at any stage.

Live spleen cell numbers decreased in proportion to the dose on day 49, but not on days 63 or 120. This decrease was significant at as low as 50 ng TCDD kg^{-1} A marked increase in tumor suppressor protein p53 was observed in the thymus of offspring on day 120. This resulted in apoptosis as determined in situ by the TUNEL method. It is suggested that TCDD can also induce p53-dependent apoptosis *in vivo.*

No significant effects on testicular weight or daily sperm production were detected on days 49, 63 or 120. Histologically, no difference in the testes and epididymis was detected between TCDD-treated and control groups. Epididymal weight and sperm reserve in the epididymis were not significantly affected by TCDD-treatment. However, among the sex-accessory glands, the ventral prostate weight was significantly reduced at 800 ng TCDD kg^{-1} on day 49 and at 200 and 800 ng TCDD kg^{-1} on day 120. Additionally, the length of anogenital distance decreased at 12.5, 200 and 800 ng kg^{-1} TCDD on day 2, at 50 and 800 ng TCDD kg^{-1} on day 63, and at more than 50 ng TCDD kg^{-1} on day 120.

These results indicate that development of rat testis and epididymis, including spermatogenesis and sperm reserve, was not affected by the TCDD doses used in the present study. However, ventral prostate weight and anogenital distance, i.e., the length of the body of the penis, were very sensitive to low levels of TCDD exposure. It is known that the penis, external genitalia, and ventral prostate are responsive to 5α-dihydrotestosterone (DHT), which is converted from testosterone by 5α-reductase. The results suggest that development of DHT-responsive tissues and organs is sensitive

to maternal TCDD exposure.

Ecological Hazard Assessment Research Team

This team is studying effects of chemical substances on aquatic organisms and/or ecosystems. A number of long-term test methods based on ecological functions were investigated for assessment of endocrine-disruptor effects on reproduction of test organisms. Two species of damselfly, *Ischnura senegalensis* and *I. asiatica*, had been maintained in a temperature- and light-controlled laboratory for several generations. Fertilized eggs (1st generation) of *I. senegalensis* were exposed to bisphenol A (nominal concentrations 0.1, 1, 10 and 100μg l^{-1}) in semi-static glass beakers to the last-instar larvae of the 2nd- generation over a period of about 5 months. Emergence of the 2nd- generation started almost at the same time in all treatments, about 70 days after oviposition, without significance difference in mortality, although few abnormal adults (distorted trunk) were observed in 10 and 100μg l^{-1} treatments. However, the mean life-span of adults (both male and female) exposed to bisphenol A significantly shortened from 14 days in the control to 10 days and 1 day at the nominal concentrations of 10 and 100μg l^{-1} ,respectively. The results suggest that the increase in the numbers of unfertilized eggs was attributable to the decrease in life-span of males exposed to bisphenol A.

Culex pipiens molestus (Diptera, mosquito) individuals, from egg to pupal stage, were exposed to 1, 10, 100 and 1000μg l^{-1} of bisphenol A. Hatchability was little affected. Emergence rate of the pupae slightly decreased in larvae exposed to bisphenol A. The sex ratio of adults (female:male) changed from 1:1 in the control to 4:7 and 3:1 at nominal concentrations of 100 and 1000μg l^{-1}, respectively. The weight of adult females decreased with increasing concentration of the chemical. This may be partly due to the presence of small females that emerged from pupae exposed to the chemical. Hatchability of eggs from the adults decreased, and this may be attributed to the increase in the proportion of females. The results suggest that reproduction of the test organisms was adversely affected by bisphenol A.

Biotechnology Products Assessment Research Team

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

Mercury resistance occurs widely in gram-negative and gram-positive bacteria that transform mercuric ions (Hg^{2+}) into the less toxic elemental form (Hg^{0}). The plasmid pSUPmer2 was constructed by inserting tandem copies of the mercury resistance (mer) operon into a broad host-range vector, and introduced into *Esherichia coli* HB101 and *Pseudomonas putida* PpY101 to increase their mercury resistance. Strains harboring plasmid pSUPmer2 had higher mercury resistance and mercuric reductase activity than did those strains harboring the plasmid pSUPmer that had only a single copy of the mer operon. The mercury resistance of *P. putida* PpY101 was significantly increased by tandem insertion of the mer operon.

It is very important to determine the fate of microorganisms introduced into the environment to cleanse contaminated soil. The sensitivity of the polymerase chain

reaction (PCR) method for the detection of *Methylocystis* sp. M. which can degrade trichloroethylene (TCE), was determined. Under optimal conditions in the PCR method studied, as few as 5 cells of *Methylocystis* sp. M could be detected.

A pilot-scale field test of bioremediation for TCE contaminated groundwater was conducted by injecting methane, oxygen, nitrogen and phosphorus to evaluate the usefulness and risks of this technology. The TCE concentration in groundwater before bioremediation was 6.7 mg l^{-1}. During the bioremediation period, 99.6% of the TCE was removed from the soil layers at 14 to 23 m depth. Clearly, biostimulation was an effective way to cleanse this contaminated soil.

Ozone and sulfur dioxide are typical industrial air pollutants. As components of acid rain and photochemical oxidants, they cause visible damage to the leaves of many plant species. It was found that the rate of ethylene evolution in leaves of tomato plants exposed to these pollutants increased significantly before any appearance of visible injury. In plants exposed to 0.2 ppm ozone, activity of 1-aminocyclopropane-1-carboxylate synthase (ACS), which is the rate-limiting enzyme in the ethylene biosynthesis pathway, was induced after one hour, while visible injury was not observed until 12 hours later. After ozone exposure, the plants could be protected against damage by application of aminoethoxyvinyglycine and 2,5- norbornadiene, inhibitors of ethylene biosynthesis and ethylene action, respectively. These results suggest that ethylene acts as a hormone, triggering a cascade of reactions leading to irreversible leaf damage.

The cDNAs encoding ACS and 1-aminocyclopropane-1-carboxylate oxidase (ACO) were isolated from ozone-exposed tomato plants. Northern hybridization showed that levels of ACS mRNA increased immediately after one hour of ozone exposure, then gradually decreased. The level of ACO mRNA remained at the initial level during ozone exposure. Exposure of plants to 1.0 ppm sulfur dioxide did not affect mRNA levels of either enzyme, suggesting that different forms of ACS may participate in plant responses to ozone and sulfur dioxide.

Urban Environment and Health Research Team

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

Public concern regarding possible health risks from residential exposure to low-level, extremely low-frequency electromagnetic fields produced by power lines has been increasing in recent years. A new project entitled Health Risk Assessments of Exposure to Extremely Low-frequency Electromagnetic Fields (ELF-EMF) began in FY1997. An EMF exposure facility was built in the Homotron (Community Health and Noise Effects Laboratory). The exposure room (approximately 3 x 3 x 3m) was designed for optimizing field uniformity of EMF, as well as for controlling room temperature and humidity. The facility has a 4-coil system that was used for each of the three orthogonal axes, north-south, east-west, and vertical. It provides flexibility of operation at different magnitudes of magnetic flux density, frequencies and polarization, and capabilities for true active-sham exposure conditions using twisted-pair wires. Volunteers were exposed to EMF in this facility and the R-R intervals (RRI) of their

electrocardiograms were recorded. Within the range of 20 to 100 μT there were no consistent and dose-dependent trends in average RRI, coefficient of variance of RRI, or spectral powers of heart rate variance.
A field survey of exposure to ELF-EMF among residences close to power lines was also conducted. The results showed that the ELF-EMF levels in the bedrooms of the houses depended on the distance from the power lines.

Comprehensive Risk Assessment and Bioassay Team

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

In FY1998, 180 chemicals were tested using human neuroblastoma NB-1 cells for primary screening. Based on the results of the screening, 32 reference chemicals were selected. Next, comparisons were made of several in vitro toxicity assays for testing the reference chemicals. The bioassays compared were cytotoxicity tests using 10 different cell lines from humans and rodents, acute toxicity tests using medaka and a daphnid, and newly developed assays using nematodes, *Paramecium* and yeast. Also investigated were the molecular mechanisms for induction of cell death, especially apoptotic cell death, by these chemicals.

International Water Environment Renovation Research Team

The focus of this team is protection of the water environment and restoration of eutrophic lakes, reservoirs and rivers through bioengineering and eco-engineering systems. Following are the main research activities.

Wastewater treatment facilities, soils and wetland systems are now considered to be important sources of greenhouse gases such as CO_2, CH_4 and N_2O that lead to global warming. For the development of adequate biological and ecological wastewater treatment technology, N_2O emission control is of great and worldwide importance. This team has conducted a theoretical study and technology development; field experiments are being studied. One of the main results is that an intermittent aeration process can be effective in controlling N_2O emission as well as in improving nitrogen removal from wastewater.

Aquatic model ecosystems such as microcosms are being extensively studied by this team for evaluating the behavior and effects of chemicals, microbial pesticides and genetically-engineered microorganisms in bioengineering and eco-engineering systems. Reproducibility and similarity to the natural ecosystem were found to be very high in research on material cycles, energy-flow and interaction in the microcosms of microorganisms, which consisted of bacteria as decomposers, micro-animals as predators, and algae as producers. Based on the above work, these approaches are being applied to predict the effect of chemical pollutants in natural ecosystems.

One very important joint research activity concerns restoration of the aquatic environment in developing countries such as the People's Republic of China and the Kingdom of Thailand, where the populations are increasing and industrial activities

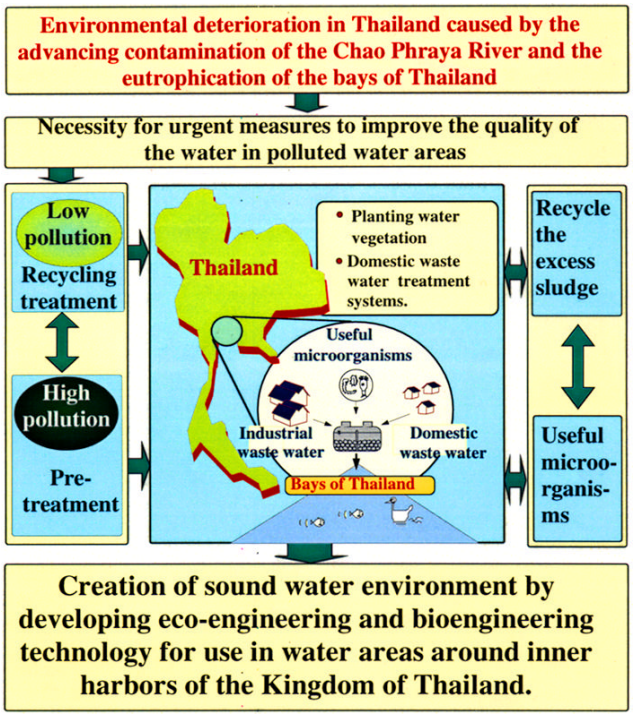


Fig. 4
Water environment restoration measures in Thailand.

Fig. 5
With Staffs of ERTC, Thailand, for the Research Concerning Bioengineering and Ecoengineering Strategy.

are growing. Development of bioengineering and eco-engineering systems such as aquatic-plant purification processes and on-site domestic wastewater treatment processes (as shown in Fig. 4) is being promoted. Figure 5 shows our counterparts in the Environmental Research and Training Center (ERTC), Thailand. From this cooperative research, it was found that wetland systems are very effective in removing nitrogen and phosphorus from domestic wastewater, and in simultaneously suppressing CH_4 emission by transforming it into CO_2 through the introduction of methane-oxidizing bacteria.

International Health Effects Research Team

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

Fluoride pollution in indoor air and the prevalence of fluorosis in rural areas of China were also analyzed. Airborne fluoride has potential toxicological significance in

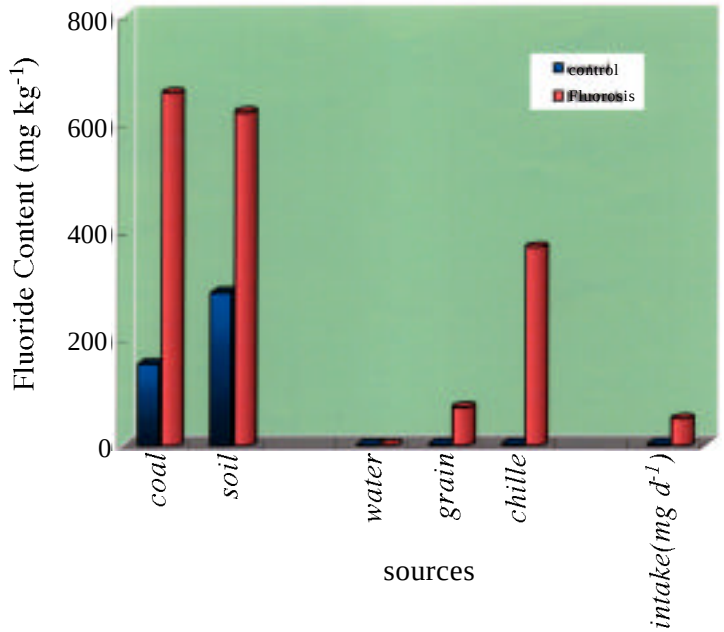


Fig. 6
Main sources of fluoride pollution in fluorosis and non-fluorosis areas in China.

Fig. 7
Diagnosis of skeletal fluorosis in the polluted area of China.

China, where an estimated 18 million people are suffering from dental fluorosis and an estimated 1,460,000 are suffering from skeletal fluorosis, both caused by coal burning. In fluorosis areas, many families use coal from local mines; coal is the main energy source for heating, drying and cooking. Since the local coal contains high concentrations of fluoride, indoor fluoride pollution and fluoride contamination in food are very serious in fluorosis areas (Fig. 6); an extremely high prevalence of dental and skeletal fluorosis (Fig. 7) has been detected through health surveillance.

International Ecosystem Management Research Team

Lake aquatic ecosystems are complex and their understanding often requires long-term monitoring or labor-intensive fieldwork. This team has been investigating trophic interactions of lake ecosystems through mesocosm experiments and by monitoring the biological and chemical environment of Lake Kasumigaura and Lake Donghu, China (with the Institute of Hydrobiology, Chinese Academy of Science). The main goal of the team's activities is to find desirable uses of aquatic resources while preserving sustainable levels of biological, commercial, and recreational values of the systems.

The team has been studying, using a set of enclosures, the responses of physico-chemical environmental variables and of zoo- and phytoplankton densities to the manipulation of the biomass of the filter-feeding planktivore, silver carp (*Hypophthalmichthys molitrix*). Silver carp are known to feed on very small plankton (<20 μm) and thus are capable of suppressing algal blooms in eutrophic lakes. During the mesocosm experiments, the abundance of large phytoplankton (>40 μm) consistently had a negative association with the presence of silver carp, while small phytoplankton (<2 μm) had a positive association with the fish. It was also found that the densities of zoo- and phytoplankton in the mesocosm were less resilient with regard to contrasting manipulations of fish stocking and fish removal than were physico-chemical variables such as DO and nutrient concentrations. Biomanipulation

using silver carp may successfully reduce the occurrence of cyanobacterial blooms in eutrophic lakes, but it may not reduce total algal biomass. The team's research has led to a better understanding of food-web structure in an aquatic ecosystem where silver carp are the top predator. However, introducing filter-feeding planktivores into natural lakes to control algal biomass and improve water clarity is still a controversial management strategy and therefore deserves more investigation.

International Atmospheric Environment Research Team

This team is investigating the origin of atmospheric aerosols, using a chemical mass-balance method, as well as chemical reaction mechanisms on the aerosol surface in highly polluted urban air in the East Asian continent. Beijing, for example, has been exposed to high atmospheric concentrations of both anthropogenic and soil aerosols originating in desert/arid areas. One research topic is designed to increase basic understanding of the environmental behavior of a soil aerosol known as kosa aerosol. The calcite mineral present in kosa aerosol may be a major contributor in reactions with acidic gases in urban air. Kosa aerosol is expected to be a key substance in either hastening or slowing environmental air pollution in big cities in East Asia.

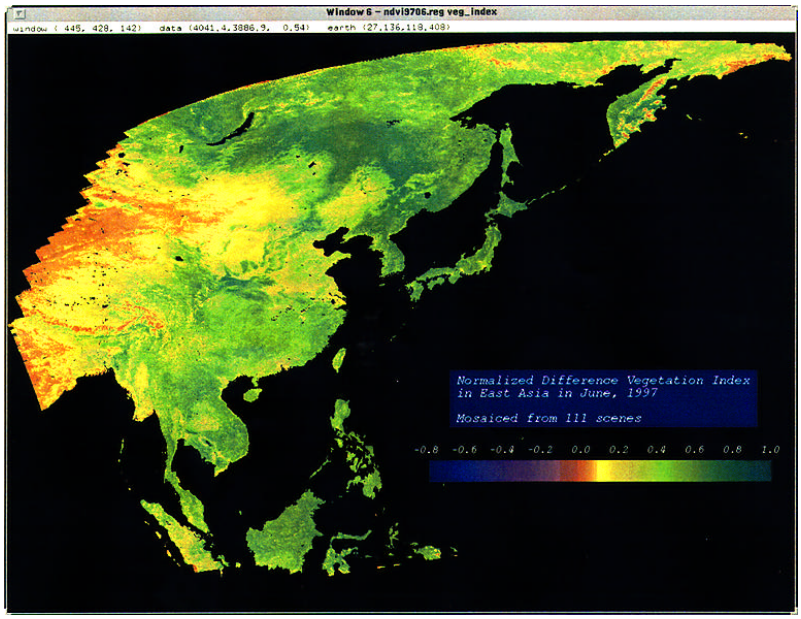
Two kinds of certified reference materials were prepared for kosa aerosol, from materials collected from surface soil in the Tengger Desert and Chinese loess soil in Gunsu Province, China, respectively (Fig. 8). These materials should not only improve quality control of analytical data related to aerosols in China and Japan, but should also be useful for studying the chemical reaction mechanisms of acidic gases and particles on the surface of kosa particles. The chemical reaction involved in the coagulation of particles with kosa and ammonium sulfate was subsequently revealed in chamber experiments by means of the reference materials. Also, the nature of the chemical reactions on the surface of kosa with NO_2 and SO_2 gases was substantiated. It was found by long-term monitoring of aerosols that mineral dust (like kosa aerosol) in Lanzhou and Yinchuan contributes considerably to total aerosol concentration in all seasons, because Lanzhou and Yinchuan are located closer to desert areas than is Beijing.

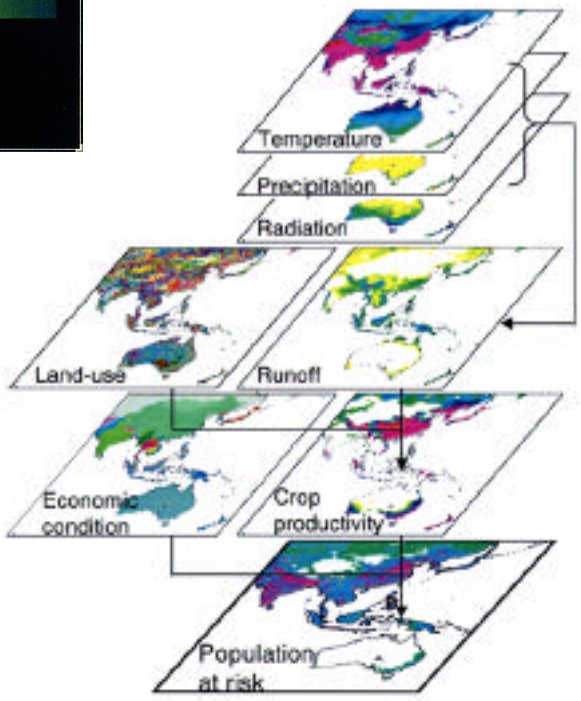
Fig. 8
Certified reference materials of CJ-1 (China loess) and CJ-2 (simulated Asian mineral dust)

Independent Senior Researchers

In addition to the above-mentioned 16 research teams, 3 independent senior researchers are working in specialized areas of environmental statistics and ecosystem preservation in developing countries.

Social and Environmental Systems Division





Geographical Information System for assessing climate change impact on human system through agriculture

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

In FY 1998, the Division, with its Principal Researcher (PR) and its four research units - the Environmental Economics (EE), Resources Management (RM), Environmental Planning (EP), and Information Processing and Analysis (IP) sections - conducted basic research on the following 11 topics.

Basic Research Topics of the Social and Environmental Systems Division

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

The first topic, which was conducted primarily by the Principal Researcher and his associate, dealt with the effects of selected basic issues on people's awareness and perceptions of the environment. The following conclusions were derived, based on theoretical discussion and analysis of various descriptions in free-association surveys conducted with local respondents. For the case of the Trans-Tokyo-Bay Highway and Greater Seto Bridge, residents on both sides exhibited clearly different environmental cognition of the construction of the Highway and Bridge, depending on whether the construction was in their own interest or seen an environmental issue in general. With regard to environmental claims, the number of such claims filed locally was found to have no relationship with population density, but was related closely to the pattern of local land use.

Environmental Economics Section

The effects of a carbon tax on the macro-economy are being studied continuously under topic (2). This year, our economic or industrial model, which has a detailed energy sector, was improved and expanded from 10 to 17 sectors, including different transport and service sectors. With this improved model, a reference case was developed along with numerous actual cases. International coordination, including that between developing and developed nation-states, is indispensable for concerted global environmental protection. In research topic (3), focusing on the Kyoto Protocol for Climate Change adopted in December 1997, an international questionnaire survey was conducted on the policy-making process in major signatory countries, which showed that the Japanese approach was clearly unique. Also an analysis was made of new mechanisms agreed upon in the Protocol, such as emission trading, joint implementation and the clean development mechanism (CDM).

Resources Management Section

Data on water quality changes in both drinking water and agricultural irrigation systems in the Lake Kasumigaura watershed were collected under topic (4), to build a model for evaluating the environmental as well as socio-economic impact of a water resource development project there. Additionally, preliminary analysis was made for improved communication to residents on the monitoring of water quality.

Topic (5) deals with the development of Life-Cycle Assessment (LCA) methodology for assessing the life cycle of resources and environmental impact of processing equipment and products that should be recycled. This year, in addition to different types of beverage containers, automatic vending machines were taken as case studies. The environmental impact associated with production, use and discard of these machines was analyzed. Simplification of analytical methodology was also considered.

Under topic (10), life-cycle analysis was conducted on different types of returnable (refillable) bottles to assess the effect of their use on reduction of environmental loading vis a vis disposable bottles. Also, using small groups of consumers, a series of experiments was performed to learn how and under what conditions their preference for returnable bottles would change. A multivariate analysis was made to identify the contribution of different factors to selection.

Environmental Planning Section

Improvement of local environmental plans is a central theme in topic (6). Many regional and local authorities, prefectural as well as municipal, are now engaged in formulation of their own basic environmental plans in conformity with the National Basic Environment Plan. In addition, the latest national legislation on measures to prevent global warming requires intensive involvement of local authorities. In this study, important common issues arising from the local planning process were carefully identified and analyzed. In the planning process, public participation at venues such as public hearings and provision of relevant information were found to be two key factors leading to public acceptance of the plans and their implementation.

Under topic (9), landscape evaluation is the main theme. An extensive review of descriptions of the Japanese landscape by Westerners was made and published. Analysis was made also of landscape descriptions by foreign visitors in the Meiji era

to identify differences from those by Japanese persons.

Information Processing and Analysis Section

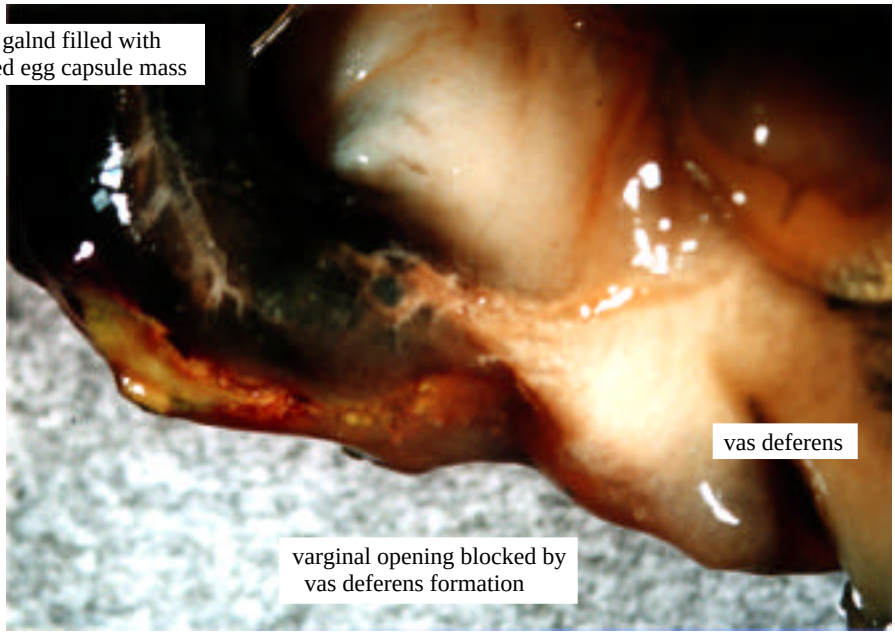
Developments under topic (7) have included improved image data-processing techniques for analysis of remotely sensed monitoring data, such as geographic and image data obtained from various earth observation satellites. Continuous image data from the NOAA/AVHRR have been obtained from the two NIES NOAA data-receiving stations, located in Kuroshima (Okinawa) and Tsukuba, respectively. Data from these stations were used to develop a regional mosaic and vegetation index map for East Asia.

Topic (8) focuses on development of models to analyze and evaluate quantitatively environmental changes, and on simulations based on these models, incorporating a new technique of transformation to predict changes. An elaborate traffic-noise propagation model was developed and improved using a boundary-element method; noise propagation under various environmental conditions was simulated more precisely than by conventional models.

Aforestation, reforestation and deforestation (ARD), defined in the Kyoto Protocol of 1997 as terrestrial CO_2 source and sink issues, are the main concern of topic (11). Interpreting the so-called “Kyoto Forest”, IPCC and FAO types were explicitly defined as an institutional option. Simulations performed in this study lead to the following conclusions: 1) Deforestation in the period (1990 to 2007) would cause net emission; however, there is no way to measure the emission before the commitment period. 2) Reforestation, in some cases, does not immediately compensate for the emission of CO_2 from deforested sites. 3) Although land-cover threshold is a transparent and verifiable criterion for defining the Kyoto Forest, global estimates of carbon released or sequestered by ARD activities are sensitive to the threshold.

Environmental Chemistry Division

Male and imposex-exhibited female of the rock shell(*thais clavigera*)



A magnified picture of the end of oviduct(capsule galnd)in severly affected imposex of the rock shell

The Environmental Chemistry Division consists of 4 sections that conduct fundamental research on environmental measurements, and on the fates and toxicology of chemicals. The Analytical Instrumentation and Methodology Section conducts research on analytical methods and instrumentation for environmental analysis, in particular using mass spectrometric systems. The Analytical Quality Assurance Section conducts research on standardization and quality assurance in environmental analysis. The Environmental Chemodynamics Section focuses on chemical state, chemical speciation and isotope analyses, as well as their application to understanding the environmental fate of chemicals. The Chemical Toxicology Section conducts studies on the chemical structure and toxicity of both natural and anthropogenic toxic compounds.

In FY1998, 11 basic research projects covering a wide range of environmental pollution by various chemicals were implemented. Also, members of the Division participated in 11 research projects organized by the project research divisions, and conducted 9 special projects subsidized by the Science and Technology Agency. Research projects on dioxins and endocrine-disrupting chemicals were intensified. Two programs supporting environmental monitoring of chemicals are continuing: the Environmental Specimen Banking Program, which has been carried out for 18 years, with special emphasis on monitoring background pollution levels around Japan; and the Environmental Certified Reference Material (CRM) Program. By the end of 1998, 19 CRMs had been prepared, 12 of which were certified for their chemical composition. In 1998, the CRM of fly ash generated from incineration of wastes was prepared; the CRM of fly ash extract was certified for dioxins.

Brief accounts of some of the important results from the Division's research in 1998 follow.

Personal exposure to volatile organic compounds and the influence of indoor air

Exposure of residents to and indoor air concentrations of 18 volatile organic compounds were monitored in Tsukuba and Tokyo, using a passive sampling method. Indoor exposure to volatile compounds except CCl_4, Freon 11 and Freon 113 was greater than in outdoor air, and it was concluded that indoor air was a principal source of personal exposure. As shown in Figure 1, individual exposure levels of *p*-chlorobenzene were related to the indoor air concentration of the substances, while some residents were exposed to high concentrations of chloroform . These high exposures would be caused from uses of the compound. Since high exposure persons for volatile compounds were students in chemistry department and residents treating organic solvents, attention should be given to ventilation when volatile compounds are used or near at hand.

Studies on the relationship between spermatogenesis in female abalone and organotin contamination

The total catch of abalone in Japan has decreased since the 1970s, although much effort has been made to enhance the stocks. Recently, the proportion of artificially produced individuals released into the sea has exceeded 95% of the total abalone captured in some areas, suggesting a decrease in reproduction in the native abalone

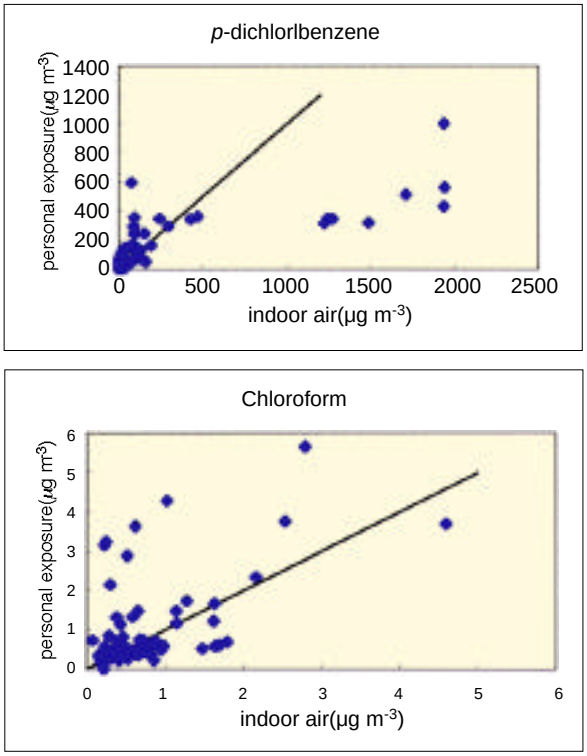


Fig. 1
Observed relationship between individual exposure and indoor air concentration of chloroform and *p*-dichlorobenzene.

stocks. A histopathological examination of gonads of abalone from a site in which the population was decreasing, showed that the peak period of maturation was different between the sexes, and 18% of the females were masculinized with testis-ovary tissues. Unhealthy gonadal features in the abalone may have caused low reproductive success. Masculinization in the female abalone is similar to "imposex" in meso- and neogastropods, which is caused by organotin compounds, such as tributyltin (TBT) and triphenyltin (TPT). Tissue concentrations of organotin compounds in the abalone from the population-decreasing site were several times higher than in abalone from a reference site. Thus, *in situ* exposure experiments to TBT and TPT at their concentrations near a dockyard were performed for 7 months; the results showed that the ovaries of 90% of female abalone exhibited spermatogenesis (spermatocyte, spermatid and semiferous tubule formation).

Accelerator mass spectrometry (AMS) research in NIES-TERRA: Development of compound-specific ^{14}C analysis (GC-AMS)/ International workshop on frontiers in AMS

For the application of AMS techniques for source identification of pollutants in the environment, a new technique for ultra-trace compound-specific ^{14}C analysis based on the combination of gas chromatography (GC) with AMS is underway. The operating conditions of the gas-ion source, a key technique for the combination of GC and AMS, was optimized and its superior performance was confirmed. Also a new large-scale sample purification technique based on preparative capillary gas chromatography was developed. These results were presented at the International Workshop on Frontiers in Accelerator Mass Spectrometry, which was held at the Ohyama Memorial Hall of the Institute, on 6 and 7 January 1999, with 64 participants including 15 overseas researchers and 40 presentations. The proceedings are available on request.

A new highly sensitive method for total microcystin determination

Microcystins, which are hepatotoxins, are produced by freshwater cyanobacteria and have been detected in drinking-water reservoirs and freshwater lakes all over the world. The World Health Organization (WHO) has recommended a guideline value for microcystin-LR in drinking water. However, over 60 microcystin variants have been found, and the acute toxicity of these microcystin variants is almost the same as that of microsystin-LR. Therefore, it is important to know the total mycrocystin content in drinking water for human and animal health. Total microcystin in cyanobacterial blooms and in freshwaters has been determined using HPLC or enzyme-linked immunosorbent assay (ELISA). However, some peptides overlap with microcystin peaks under the condition of reverse-phase HPLC analysis, and the binding constants of the antibodies of ELISA and microcysitin variants also vary. These facts suggest that HPLC and ELISA are not suitable for exact total microcystin determination in natural samples.

For this purpose, a total microcystin determination method based on quantitative analysis by GC or HPLC of 2-methyl-3-methoxy-4-phenylbutyric (MMPB) as an oxidation product of microcystin, has been developed. In the method, MMPB in the pmol range of concentrations was determined.

However, a more highly sensitive analytical method for total microcystin is required for monitoring, and this has been developed using erythro-2-methyl-3-(metoxy-d_3)-4-phenylbutyric acid (MMPB-d_3) as the internal standard. Using GC/CI-MS, *m*/*z* 233 for MMPB methyl ester and 236 for MMPB-d_3 were monitored, and the retention times of methyl esters of MMPB and MMPB-d_3 were found to be almost the same. Methyl MMPB was determined quantitatively from the peak ratios of *m*/*z* 223/226. The detection limit for methyl MMPB was 0.1 ng (0.43 pmol). Based on an average molecular weight of microcystin variants of 1000, the detection limit (0.1 ng of MMPB) is equivalent to 0.43 ng of microcystin.

These results demonstrate that this method is very sensitive for quantitative analysis of total microcystin, and can be applied to the monitoring of microcystin in drinking water, reservoirs and freshwater lakes.

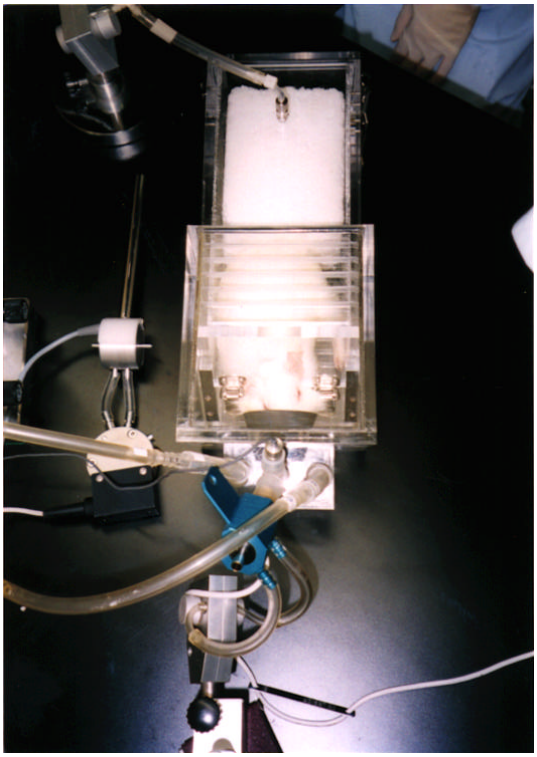
Estimation of physical and chemical properties of dioxins by molecular orbital calculation

In order to assess environmental risks from polychlorinated dibenzo-*p*-dioxins (PCDDs), the environmental fate of these chemicals must be known. Research on the behavior of PCDDs requires a database of molecular properties. Chlorinated dioxin, for example, has a great number of isomers. However, experimental information on molecular parameters is hard to obtain. In the absence of experimental data, ab initio molecular orbital and Density Functinal Theory(DFT) calculations may be used to provide vital information about the molecular parameters of these molecules. The structure, energy, vibrational frequencies and potential energy curve of 2,3,7,8-tetrachlorinated dibenzo-*p*-dioxin and the physical and chemical properties of dioxins, such as ionization energy and electron affinity, have been studied and determined.

Environmental Health Sciences Division

Diesel engine

Exposure chambers



Apparatus to measure sneezing response

The mission of the Environmental Health Sciences Division is to study interactions of humans with harmful chemical and physical agents in the environment and to provide the scientific basis to perform risk assessment of these agents, alone or in combination, in humans. Due to the wide spectrum of research areas, the Division's research activities are performed in experimental and epidemiological settings. During the last few years environmental contamination and possible health effects due to dioxins and endocrine-disrupting chemicals have become social and even political issues. The Division has thus formulated special research projects to provide basic knowledge which will be useful for risk assessment of these compounds in the future. Other compounds and agents like nitrogen dioxide, diesel exhaust particulates (DEP), heavy metal compounds, Japanese cedar (sugi) pollen, ultraviolet radiation, and noise, are also research topics of the Division. Depending upon the distribution of a given agent in the environment and its possible health effects, a research topic is classified as relating to either domestic or global environmental issues.

During FY1998, twelve regular research programs were carried out. Experimental studies were performed in three sections: Biochemistry and Physiology, Experimental Pathology and Toxicology, and Biological and Health Indicators. Studies that deal with human populations were carried out in the Environmental Epidemiology Section. Research objectives that were considered relevant to both domestic and global environmental issues have been also pursued as research projects or programs supported by the Global Environment Research Program or Special Research Program, in collaboration with scientists of the Global Environment and Regional Environment divisions. In addition, research projects supported by the Science and Technology Agency and other funding bodies were also performed. In the following, studies on the effects of diesel exhaust (DE) on pulmonary functions are summarized, focusing upon the incidence of rhinitis, by utilizing the sneezing response as a very useful marker.

The incidence of allergic rhinitis appears to be increasing, particularly in industrialized countries. Epidemiological studies have shown that the prevalence of allergic rhinitis in areas of air pollution is higher than that in unpolluted areas. In Japan, the number of diesel-powered cars, which emit 20 to 100 times more particulates and 2 to 20 times more nitrogen oxide than gasoline-powered cars, has increased 2 to 3 fold over the past 10 years. It has been suggested that DE has contributed to the increased prevalence of allergic rhinitis. Therefore, this division investigated whether or not exposure to DE aggravates the nasal allergic reaction induced by repeated nasal administrations of an antigen.

Guinea pigs were exposed to filtered air or to DE (containing 0.3 or 1.0 mg m^{-3} of DEP) for 5 weeks. During the exposure, the guinea pigs were administered with an antigen or saline into both anterior nares once a week. Sneezes and nasal secretions were measured for 20 minutes after ove-albumin (OVA) administration. Altered airflow at the nose and box pressure changes in time with the onset of sneezing were measured using a pneumotachograph connected to a differential pressure transducer (Fig. 1). Titers of specific anti-OVA-IgG and anti-OVA-IgE and the number of eosinophils that infiltrated the nasal epithelium and subepithelium were measured 24

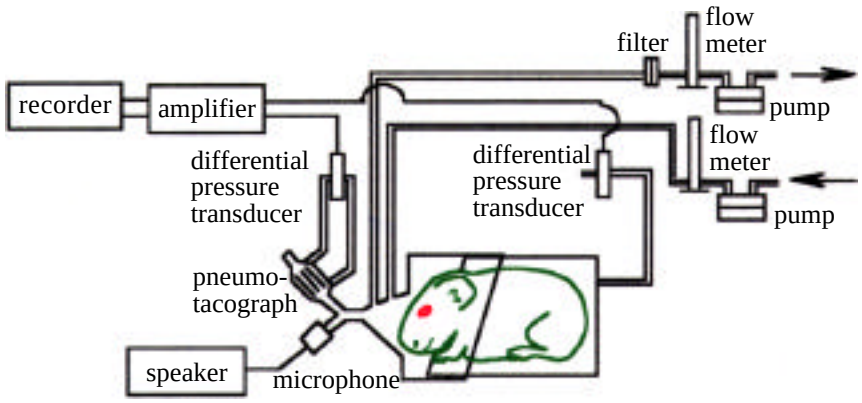


Fig. 1
Scheme of measurement of sneezing response.

hours after the last administration of OVA. The results show that exposure to DE enhances the incidence of sneezing and the amount of nasal secretion induced by repeated nasal OVA administration in a concentration-dependent manner (Figs. 2 and 3). This study is the first to show physiological and histological evidence of DE enhancement of an antigen-specific nasal allergic reaction.

Many factors, such as nasal mucosal responsiveness to chemical mediators released by antigen-antibody reactions (such as histamine (His), anti-OVA-IgG and -IgE), nasal epithelial permeability, infiltration of inflammatory cells into the epithelium and subepithelium, and stimulation of sensory nerve endings, are believed to play important roles in the onset of the nasal allergic reaction. Chemical mediators, neuropeptides, and cytokines released into the nasal microenvironment may affect these factors.

This division previously reported that short-term and relatively long-term exposure to DE enhances nasal mucosal responsiveness to His (Kobayashi et al., 1997, 1998). DE contains DEP and many gaseous components such as nitrogen dioxide (NO_2), nitric oxide (NO), sulfur dioxide (SO_2), and formaldehyde. The division has now shown that DEP increases nasal mucosal responsiveness to His. Gaseous pollutants in DE may affect nasal mucosal responsiveness. Air pollutants such as NO_2, NO, SO_2, sulfuric-acid aerosol, and formaldehyde can induce airway hyper-responsiveness. Titers of specific anti-OVA-IgG and anti-OVA-IgE significantly increased in animals exposed to DE in a concentration-dependent manner. These results indicate an adverse effect of DE on the nasal allergic reaction.

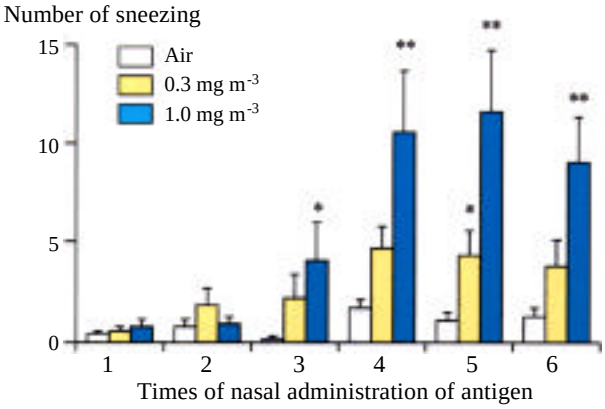


Fig. 2
Effect of exposure to DE on sneezing response induced by repeated antigen administration.

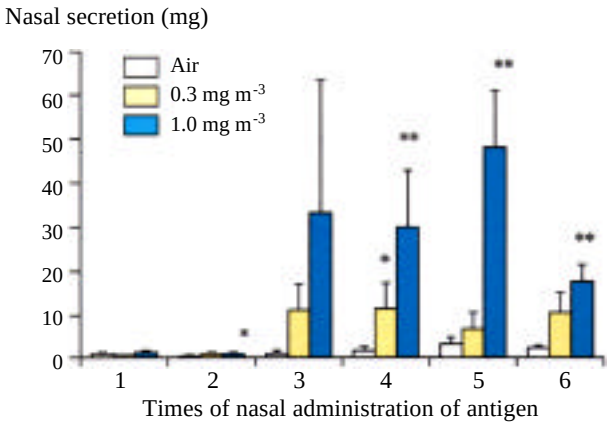


Fig. 3
Effect of exposure to DE on nasal secretion induced by repeated antigen administration.

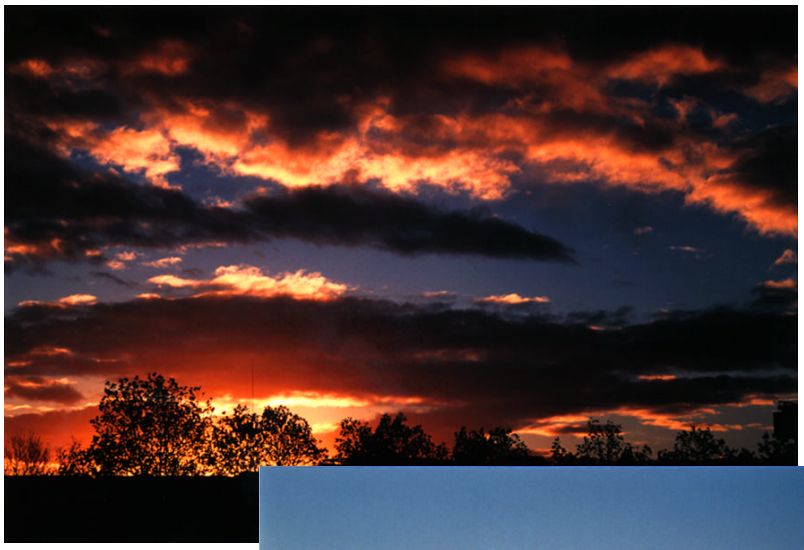
Exposure to DE enhances antigen-specific IgE antibody production in mice through increases in interleukin-4 (IL-4) and IL-10, and a decrease in interferon-gamma production. The intranasal administration of DEP, or exposure to extremely high concentrations of NO_2 or SO_2 with an allergen, enhances allergen-specific IgE and IgG antibody production. The effects of exposure to NO_2 at low concentrations, and to NO, formaldehyde and other gaseous chemicals on allergen-specific IgE and IgG antibody production remain to be elucidated.

The enhanced permeability of the nasal airway epithelium facilitates penetration of the epithelial barrier. This division reported that nasal epithelial permeability to horseradish peroxidase (HRP) with a molecular weight of 40,000 daltons, increased in animals exposed for 28 days to DE containing 1 or 3.2 mg m^{-3} of DEP. Therefore, exposure to DE under the concentrations studied here may increase nasal epithelial permeability, which could play an important role in producing the nasal allergic reaction. Among the components of DE, our preliminary results show that the intranasal administration of DEP enhances nasal epithelial permeability to HRP. Exposure to NO_2, SO_2, or formaldehyde also enhances the permeability of tracheal or pulmonary epithelium. However, little is understood about the effects of DE components on the permeability of nasal mucosal epithelium.

Exposure to DE augmented the number of eosinophils infiltrating both the nasal epithelium and subepithelium induced by nasal OVA administration. Infiltrating eosinophils may release toxic granular proteins, such as major basic protein, eosinophil cationic protein and eosinophil peroxidase, which could damage or desquamate nasal epithelial cells as observed in asthma patients. Epithelial damage enhances epithelial permeability, stimulation of sensory nerve endings and the release of chemical mediators. Therefore, eosinophilic airway inflammation plays a key role in the aggravation of allergic rhinitis. Stimulating the peripheral terminals of sensory nerves results in sneezing, nasal secretion and nasal congestion. This division reported that DEP induces vascular permeability in the skin and the sneezing response. Pretreatment with capsaicin inhibits the increase in vascular permeability and the sneezing response induced by DEP (Kobayashi, unpublished data).

DE from a combustion process contains many gaseous irritants such as formaldehyde as well as unknown irritants that induce sneezing, nasal secretion and nasal congestion. Therefore, DEP and gaseous irritants could stimulate sensory nerves and induce the release of neuropeptides such as substance P and calcitonin gene-related peptide from peripheral terminals of the trigeminal nerves. Therefore, the sneezing response and nasal secretion induced by antigen-antibody reactions may have been augmented by transmitters released by exposure to DE. Arachidonic acid metabolites, such as prostaglandin (PG) $F_{2\alpha}$ and PGE_1 can potentiate the secretion induced by cholinergic stimulation. DE and components of DE such as NO_2, SO_2 and acids affect arachidonic acid metabolism. Therefore, the nasal response induced by antigen-antibody reactions was possibly augmented by inflammatory mediators released by exposure to DE. The effect of exposure to DE on the release of transmitters and inflammatory mediators corresponding to the aggravation of the nasal allergic reaction remains to be elucidated. The main finding to date is that exposure to DE enhances the nasal allergic reaction induced by repeated antigen-administration in guinea pigs.

Atmospheric Environment Division



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

Atmospheric Physics Section

Research in the Atmospheric Physics Section is focused on numerical modeling and data analysis of atmospheric dynamics and climate systems. A major research topic is analysis of the global and regional climate system using observational data and the CCSR/NIES climate model developed through joint research with the University of Tokyo. The results facilitate studies of both global- and regional-scale environmental issues such as the evaluation of climate change. Related research topics include evaluation of the effect of greenhouse gases, aerosols and water vapor on global-scale climate change, and the development of a regional climate model that includes land-surface processes in East Asia. Other specific research themes include water exchange between the atmosphere and land, improvement of parameterization of cumulus convection, effects of the tropical cumulus convection system on global-scale circulation, derivation of tropospheric aerosol parameters from satellite data, air-parcel motion in the tropospheric cyclonic vortex and stratospheric polar vortex, etc.

Chemical Reaction Section

The Chemical Reaction Section deals with photochemical and thermal reactions of reactive atmospheric constituents. Studies of the photochemistry of free radicals, kinetics and mechanisms of atmospheric reactions, and field observations of reactive species related to photochemical ozone formation and acid deposition have been carried out.

Laser-induced fluorescence of methyl-substituted vinoxy radicals

Laser-induced fluorescence spectra of the 5 methyl-substituted vinoxy radicals (CXY-C(O)Z, X, Y, Z = H or CH_3) were observed at 330 to 370 nm. Substituted radicals were produced by photolysis or Cl or F reactions with ketones, aldehydes or ethers. These radicals are also produced when oxygen atoms react with olefins, such as propene, 2-butene, isobutene, 2-methyl-2-butene, and 2,3-dimethyl-2-butene. The detection of methyl-substituted vinoxy radicals enables formulation of the mechanisms of O + olefin reactions.

Mechanisms of the reactions between ozone and natural hydrocarbons forming hydroperoxides

Reactions of α-pinene or one of the methylcyclohexenes (1-, 3-, and 4-methyl derivatives) with ozone in air were investigated in a large-volume photochemical reaction chamber in order to elucidate the reaction pathways that form hydroperoxides. Clear contrast in product yields was observed between the hydrocarbons with a methyl

Fig. 1
Concept illustration of ELISE (courtesy of NASDA).

group on the double bond (α-pinene and 1-methylcyclohexene) and those without this methyl group (3- and 4-methylcyclohexene). Peroxyacetic acid was formed from the former, but not from the latter hydrocarbons. The yield of methyl hydroperoxide was higher with the former hydrocarbons. On the basis of these results, mechanisms to form hydroperoxides in ozone reactions were proposed.

Upper-Atmospheric Environment Section

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

The space-borne lidar "ELISE" also known as "MDS-2/Lidar" is being developed by the National Space Development Agency (NASDA) of Japan for launch in 2002 (Fig. 1). This sensor will be an effective tool for observing global distribution of clouds and aerosols. ELISE is a two-wavelength Mie-scattering lidar with 3 detection channels (an analog and a photon counting channel at 1053 nm, and a photon counting channel at 527 nm). A study has been conducted on data-reduction algorithms and data-utilization methods for ELISE (Fig. 2). Stratospheric aerosols, cirrus clouds, lower clouds, dust layers, the planetary boundary layer, etc. will be the target of observations.

Aerosols and clouds have been observed continuously in Tsukuba using a ground-based Mie-scattering lidar. A climatological study has been carried out from the radiative transfer aspect in a study on global warming. Optical characteristics of cirrus clouds and aerosols are being studied with new techniques such as high-spectral-resolution lidar. Observations in Jakarta using lidars have been conducted since 1997. Lidar observations to study global distribution of aerosols and clouds started in 1998, using the research vessel "Mirai".

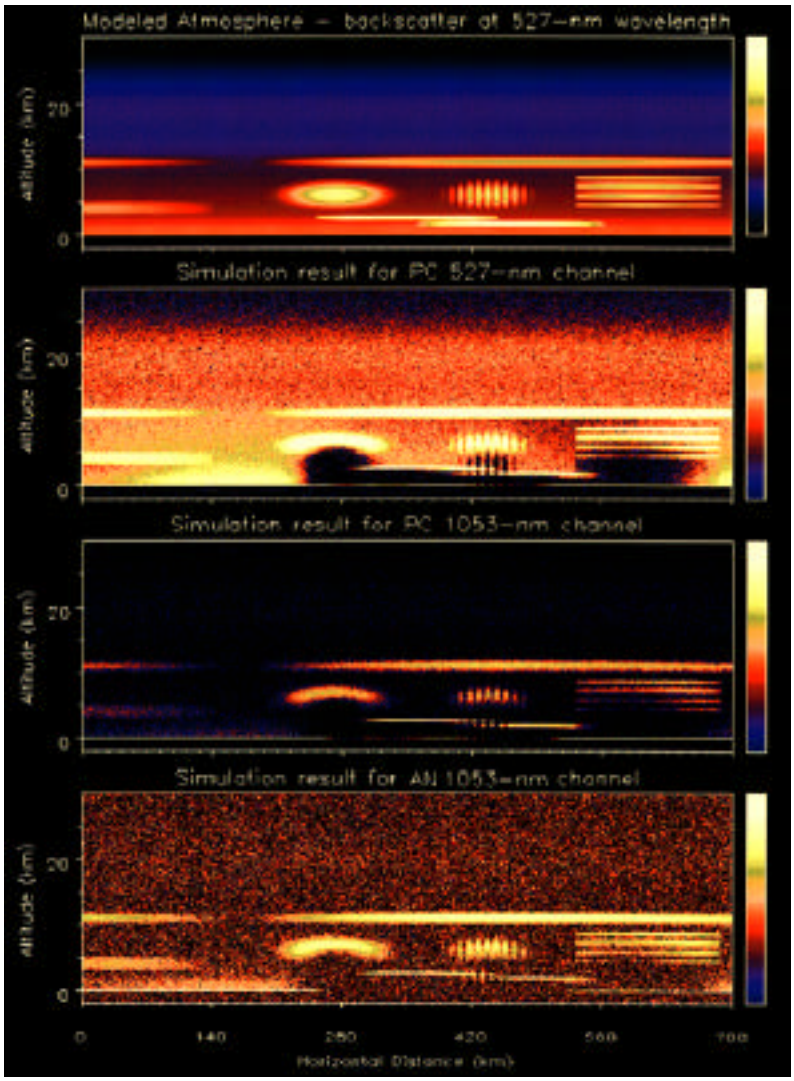


Fig. 2
Example of a simulation study. Modeled backscatter by clouds and aerosols (top panel), and simulated signals from the 3 detection channels (lower 3 panels).

Atmospheric Measurement Section

The special emphasis of the Atmospheric Measurement Section is on field studies of trace atmospheric constituents including greenhouse gases, reactive chemical species, and aerosols. To understand their origins, distribution and fate in the troposphere, measurements of their concentration and isotopic composition have been carried out on a global and/or regional scale. A method for measuring the O_2/N_2 ratio in the background atmosphere using gas chromatography was developed to obtain information on the global transport process of carbon dioxide emitted from fossil fuel combustion and then absorbed into the hydrosphere and biosphere. Analytical precision as high as 2 ppm was achieved, and measurements were made on air samples taken at Hateruma and Ochi-Ishi monitoring stations. On Hateruma Island, a distinct seasonal variation was found in the O_2/N_2 ratio: an increase in summer and decline in winter. The abundance ratios of stable isotopes ^{13}C and ^{18}O in carbon dioxide were also measured, and their vertical distribution and seasonal variation were ascertained.

It is indispensable to evaluate the amount of dry deposition of atmospheric pollutants in order to grasp their total transport behavior; current data are quite deficient. Therefore, field measurements of dry deposition velocities of SO_2, O_3 and NO_2 were carried out in fields where beans, wheat, and corn are grown. Deposition velocities of O_3 and SO_2 were measured also for a red-pine forest and for Chinese soils.

Water and Soil Environment Division

The Water and Soil Environment Division conducts both fundamental and applied research on transport, biological degradation and chemical reactions of pesticides, organic matter, heavy metals, chlorinated aliphatic compounds, and 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: Water Environment Engineering, Water Quality Science, Soil Science and Geotechnical Engineering. 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

Development of a comprehensive watershed management model for the Changjiang River

The remarkable progress in economic and social activities in the Changjiang River catchment may damage not only the catchment but also the East China Sea. Researchers in this section have developed a mathematical model that describes and simulates aquatic environmental conditions in the watershed. The objective is to determine ways toward sustainable development by preserving the functions of terrestrial and aquatic ecological systems from the river catchment to the sea. The final goal is to establish a comprehensive watershed management model for the Changjiang River catchment. Mathematical models based on physical backgrounds can be applied to a watershed, irrespective of its size. However, the Changjiang River catchment is so huge that a special model is required; its applicability has to be verified step by step. This comprehensive model consists of three systems: a monitoring system, a geographic information system (GIS), and a transport system for water and materials. A field survey is also necessary for verifying the characteristics and mechanisms of the ecological system and water quality in the specified area. In FY1998, all aspects of the system were extensively developed.

1) Construction of a database of environmental information on the Changjiang River.
In collaboration with the Changjiang Water Resources Commission, Ministry of Water Resources, People's Republic of China, a database has been constructed of the relationships among water stage, flow discharge, sediment transport rate and water quality at the main stations in the upstream region of the Changjiang River.
2) Construction of a system of analysis of flooded areas.
The second-largest flood in the last five decades occurred along the whole Changjiang River last summer. Estimation and verification of the flooded area provide fundamental and important information for evaluating the impact of flood damage on various economic and social activities. Hence, a system has been developed that calculates the flooded area and volume of floodwaters based upon satellite images and GIS.
3) Development of a transport process model for water and sediment.
A transport process model for water and sediment was applied to the upper reaches of the Changjiang River from its source to Yichang, which is located just downstream

of the Three Gorges dam site. The simulated results agreed reasonably well with the field data, with some discrepancies that are presumed to be related to the degree of accuracy of data on spatial and temporal distribution of precipitation.

4) Field survey of water quality and the ecological system.

A field survey was conducted from 28 October to 14 November 1998 using a Chinese research vessel on the Changjiang River from Chongqing to Shanghai (about 2300 km), with stations at intervals of 50 to 100 km; water samples were collected for analysis at 40 sites. At 4 specified stations, the role of microbial food webs, including both the bacterial and photosynthetic pathways of the carbon cycle, was investigated to learn the fundamental characteristics of the Changjiang River's aquatic ecological system.

Water Quality Science Section

Evaluation of natural cleansing capability of microorganisms in polluted environments, using the stable isotope technique

The effect of the load and storage of pollutants in the water-soil environment on organisms and ecosystems is an environmental issue. In order to understand the behavior of pollutants and their ecological affects in such environments, studies are being carried out on the organisms associated with their decomposition and on assessing their metabolism and decomposition ability. In FY1998, techniques using the stable carbon isotope ratio were examined for evaluation of the natural cleansing capability of indigenous microorganisms in water-soil environments polluted with artificial organic substances.

A semi-closed beach simulator (containing 4.5 kg of beach sand) that provides control of the tidal cycle was prepared. The rate of carbon dioxide generation from the simulator, following the decomposition of natural organic substances adhering to the sand, was determined daily for 20 days. The carbon isotopic ratio ($\delta^{13}C$) of carbon dioxide was also determined. In another simulator, weathered C-heavy oil (10 g) was added as an organic pollutant and similar measurements were made.

The generation rates of carbon dioxide from the control and oiled simulators were similar, 9 to 12 mgC day^{-1} and 7 to 11 mgC day^{-1}, respectively. It was difficult to estimate the decomposition rate of organic substances from only the generation rate of carbon dioxide in this experimental condition. However, the carbon isotopic ratios in the oiled simulator were significantly lower ($\delta^{13}C$ = -16.5‰) than those in the control ($\delta^{13}C$ = -12.9‰). The $\delta^{13}C$ value of the oil itself was -32.1‰, lower than that of natural organic matter (e.g. algae). Therefore, it is probable that the carbon isotopic ratio in carbon dioxide from the oiled simulator decreased following decomposition of the oil. The oil degradation rate, evaluated using the relationship of carbon isotopic conservation, was 1.1 to 2.4 mgC day^{-1}. This study shows that the stable carbon isotope technique can be applied to evaluation of natural cleansing capability of environments polluted by artificial organic matter.

Soil Science Section

Adsorption of organic compounds on hydrous iron oxides

The fate of organic matter in the soil is strongly affected by its ability to adsorb onto soil particles. To understand the adsorption behavior of organic compounds, knowledge is required not only of the chemical characteristics but also of the steric configuration of the compounds. In this study, a group of monosaccharides that have similar chemical

characteristics but different configuration were selected as model compounds. Hydrous iron oxides was used as model soil particles. Ability of each monosaccharide to adsorb was compared using the Langmuir constant. Adsorption of D-Galactose on hydrous iron oxides was stronger than that of D-Glucose. From comparison of 15 monosaccharides (including D-Galactose and D-Glucose), the hydroxyl groups which form tighter formation were found to enhance adsorption.
Further investigation was done using monosaccharide derivatives. Adsorption of D-Galacturonic acid was stronger than D-Glucuronic acid, and adsorption of D-Galactose-6-phosphate was stronger than that of D-Glucose-6-phosphate. From these experiments, steric configuration of hydroxyl groups in the molecule was found to influence adsorption behavior of organic compounds.

Geotechnical Engineering Section

Land subsidence in Takada, Japan

Urban Takada, situated south of the city of Joetsu in western Niigata Prefecture, is a typical heavy snowfall area in Japan. The groundwater level decreases greatly in winter due to excessive pumping of groundwater to melt snow, resulting in subsidence caused by consolidation of Quaternary deposits.

The G_0, G_1 and G_2 beds are aquifers and C_0, C_1 and C_2 beds are confining strata (Fig.1). From a geological point of view, the C_1 bed is mainly composed of very soft clay mixed with humus, and accordingly its contraction capacity is large.
When observing a change in groundwater level, the decline in the level of the G_1 bed is largest in winter. It is considered that the process of consolidation of the C_1 bed is attributable to a strong decline in the level of the G_1 bed.

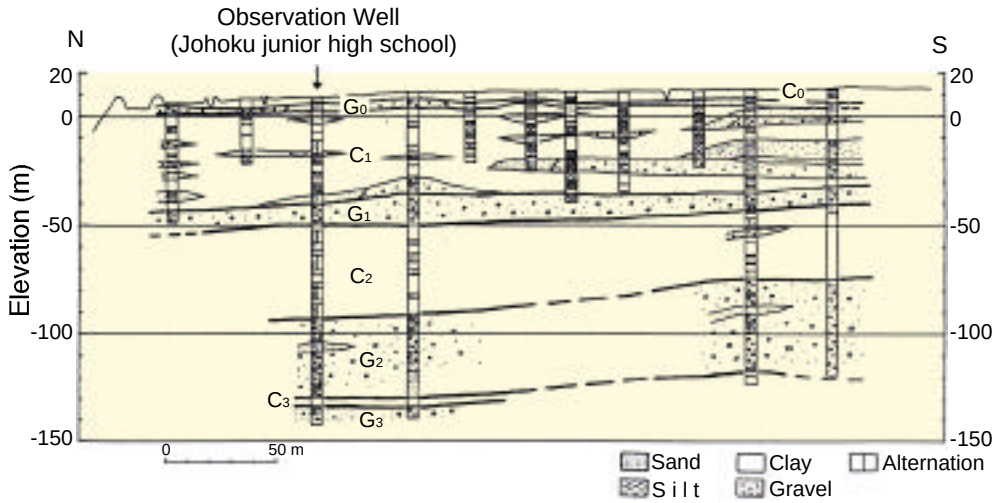
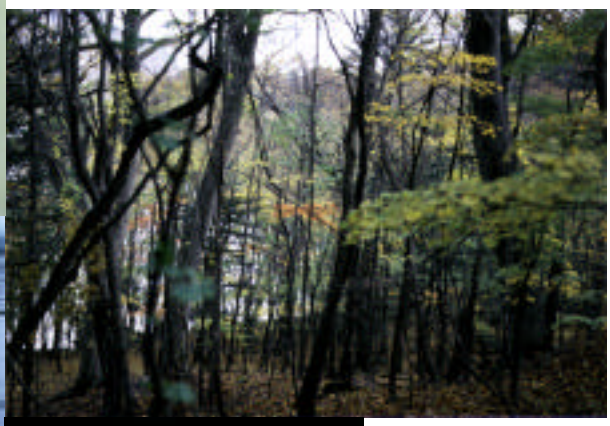
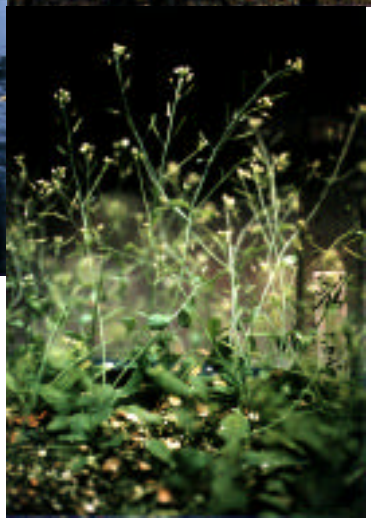


Fig. 1
Geological section at the Takada Urban District, Joetsu.
(Tohno & Sekiya, 1997)

Environmental Biology Division





The Environmental Biology Division consists of four sections: Molecular Biology, Environmental Microbiology, Environmental Plant Science, and Ecosystem Study. The Division performs basic and applied research on the effects of various kinds of environmental stress, both chemical and physical, on organisms at various levels, from molecules and cells to individuals, species, populations and ecosystems. The Division's work is also directed towards the conservation of genetic biodiversity, species and ecosystems. In 1998, the Division performed 16 studies funded by NIES, one study funded by the Environmental Research and Technology Division (Environment Agency), four studies funded by the Science and Technology Agency, and one study funded by the Environment Agency.

Molecular Biology Section

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

Since plants do not have the ability to move, they must endure various adverse environmental conditions in order to survive in nature. It is necessary to understand the underlying mechanisms of such tolerance in order to develop new techniques in environmental preservation. It is especially important to identify and isolate the genes involved in protective mechanisms in various stress conditions. Research on this topic is being carried out using molecular genetic approaches with *Arabidopsis thaliana*. Nineteen *Arabidopsis* mutants sensitive to ozone, an air pollutant, and 11 mutants sensitive to cold temperature in the light have been isolated. We examined the sensitivities of these lines to various stress factors and found that some are specifically sensitive to ozone or low temperature, while others are sensitive to several stress factors (Table 1). These results suggest the existence of genes that are involved in tolerance to ozone or to low-temperature stress only, or to a few different stress factors in common.

Table 1 Tolerance of Arabidopsis mutant lines to various kinds of stress factors.

Mutant line	Tolerance to					
	O_3	SO_2	UV-B	Low temp	High light	Darkness
LT2459-1	+	?	?	0	0	?
LT2361,LT2404	—	—	0	—	0	?
LT2382	—	—	0	0	0	?
OS-35,OS102	—	—	?	0	0	0
LT2557-1	—	0	0	—	—	?
LT2490-1	—	0	0	—	0	?
OS-1,OS118	—	0	?	0	0	0
LT2416,LT2424	0	0	0	—	0	?
LT2398-1,LT2442-2	0	?	?	—	0	?
LT2512,LT2568-1	0	?	?	—	0	?
LT2367	0	?	?	—	?	?

+, –, 0 : higher than, lower than or similar to the wild-type line, respectively
O_3 : 0.2 ppm, SO_2 : 1ppm, UV-B : 0.36 Wm^{-2}. LOW temperature : 5˚C,
High light : six-fold higher irradiance than that of growing condition
Darkness : in the dark for 5 days

Fig. 1
Cdony morphology of the five morphospecies of *Microcystis*.

Environmental Microbiology Section

Studies on environmental microbiology have included 1) diversity of microorganisms; 2) distribution and culture of charophytes that are in urgent need of protection; 3) diversity of algal-lytic bacteria, which may affect the blooming of microalgae in eutrophic lakes; 4) systematics of haptophyte algae, which include calcareous species responsible for adsorption of carbon dioxide.

Identification of real taxonomic groups is necessary for assessing the diversity of microorganisms. Cyanobacteria often cause noxious water blooms in lakes and reservoirs. Among them the genus *Microcystis* has attracted a great deal of public attention because of its toxin production. Five morphological species of *Microcystis* have been reported in Japanese waters (Fig. 1). However, the morphology of these organisms is rather simple, thus, species delimitation is always open to argument. These morpho-species were re-evaluated using physiological and genetic properties, such as optimum growth temperature, salinity tolerance, pigment composition, PCR-RFLP of cpcBA-IGS, DNA-DNA hybridization and 16S rDNA sequences. The results showed no clear difference among the five morpho-species. It was concluded that they should be integrated into a single species, *Microcyctis aeruginosa*, the type species of the genus.

Environmental Plant Science Section

Research efforts in environmental plant science were on 1) the effects of desertification and global warming on plants; 2) amelioration of air pollution by plants; 3) strategies to prevent desertification; 4) conservation of alpine and subalpine plant species; and 5) new techniques for diagnosing stress in plants.

To prevent desertification in China, ecophysiological characteristics of Chinese desert plants were studied. The effects of NaCl on the growth of *Haloxylon ammodendron*, a shrub distributed in both saline and non-saline lands in desert regions of northwestern China, were examined. It was found that this species is very tolerant to salinity in its initial developmental stage but becomes sensitive to salinity when mature. To understand this phenomenon, the Na content of young non-transpiring and old transpiring seedlings grown in media of different NaCl concentrations was compared (Fig. 2). The results showed that Na concentration in plant tissues of old seedlings was considerably higher than that of young seedlings. The transpiration stream from root to atmosphere through the plant body may result in the accumulation of salt in tissues of old seedlings. The higher sensitivity of this species in the mature stage is likely due to this salt accumulation.

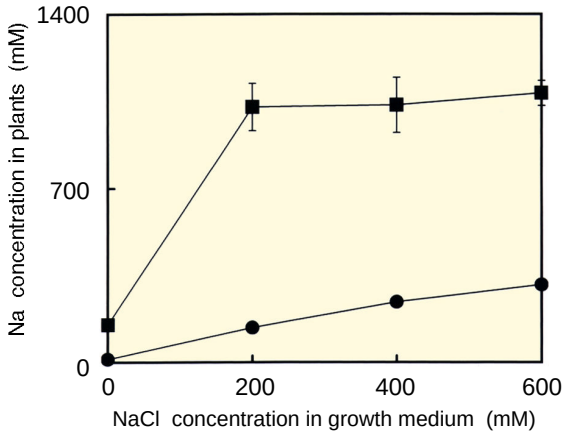


Fig. 2
Na concentration in 1- to 3-day-old and 100-day-old seedlings of *Haloxylon ammodendron* grown in media of different NaCl concentration. ● and ■ represent Na concentration in plant tissues of the young and old seedlings, respectively.

Ecosystem Study Section

Ecosystem research has included 1) studies on the process of restoration of disturbed ecotone ecosystems of lakes; 2) the significance of natural firefly populations as an indicator of the status of the environment; 3) studies on benthic habitats in the littoral zone of lakes; 4) basic research on the classification and ecology of lotic macroinvertebrates; 5) effects of chemical pollutants on the benthic community as a complex system; and 6) comparative studies on population dynamics of wetland macrophytes.

The distribution of submerged plants in Lake Oze-numa, especially *Elodea nuttallii*, an exotic species that invaded the Lake between 1980 and 1981, has been studied. Lake Oze-numa is within a national park; thus only a hand-held sonar, a CCD camera and a differential GPS monitor were used in order to minimize ecological disturbance. The survey showed the exact shape of the lake basin and vegetation (Fig. 3). A comparison of survey data with past information on lake vegetation showed that the distribution of *E. nuttallii* has decreased in the north and southwestern parts of the littoral zone and other native species have regenerated. There were, however, unchanged parts since 1980 in the eastern littoral zone, close to the outlet of small river. The station, close to the mouth of the Ooe River, was initially invaded by *E. nuttallii*. There is supposed to be constant populations of *E. nuttallii* at the sites because *E. nuttallii* prefers eutrophic and muddy conditions and/or the area is supplied with fragments of plants that undergo vegetative reproduction for the prevailing winds.

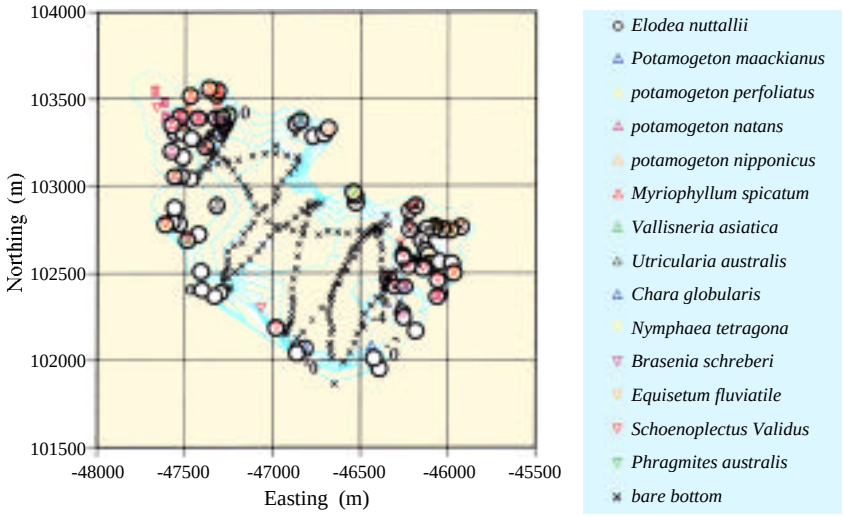


Fig. 3
The exact lake basin shape and distribution of aquatic macrophytes in Lake Oze-numa. Contour interval is 1 meter. The coordinate system is Japanese State Plane; the coordinate zone in this is JSP IX.

Environmental Information Center

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

Database Section

Processing and Provision of Environmental Information Databases

1) Monitoring data files.

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 to (in computer-accessible form) data files of air quality and water quality monitoring data, which are transmitted by local governments to the Environment Agency under the Air Pollution Control Law and the Water Pollution Control Law. These data files are provided to outside users including other governmental organizations and laboratories. Also a duplication service for use by the general public is available for some files. In addition data files are exchanged with other governmental organizations.

2) Natural environment.

Development of a General Reference System for the Natural Environment began in FY1991, with the aim of providing basic reference materials that facilitate both understanding of present conditions and forecasting of changes in the natural environment. A database system (GREEN) using a UNIX database server is available on NIESNET to enable searches for and display of environmental data from all over Japan. Since FY1995, a system to provide database access by personal computers (PGREEN) has been developed, based on previously recorded results and data. PGREEN is available on Windows-based PCs, enabling graphical display and user-friendly operation.

3) Environmental information source information.

Surveys of environmental information have been in progress since FY1992, 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) and explanations of laws, treaties and terms concerning the environment—were compiled on CD-ROM and are being distributed to the general public through a public corporation and through NIES and EICnet WWW servers. We call the database of environmental information sources the “EI-Guide”.

NIESWWW

In March 1996, NIES began to provide environmental information on NIES research activities and results (in English and in Japanese) to the world via Internet (URL http://www.nies.go.jp/).

EICnet

In March 1996, the Center established a computer communication system for the general public called the “Environmental Information & Communication Network” (EICnet) in accordance with the Basic Environment Law, in order to promote national activities for conservation of the environment. This system is available only in Japanese

via Internet and facsimile. In January 1997, an EICnet WWW server was also established (URL http://www.eic.or.jp/). In December 1997, the Center started to provide environmental information by facsimile.

Library and Research Information Section

Compilation of documentary information on environmental research

Documentary information concerning the environment is essential for competent environmental research and management. 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.

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

Library management and operations

As of March 1999, 39 310 books, 743 technical and scientific serials, 8501 maps, 110984 microfiches, and various other reports and reference materials were held in the NIES library. Library facilities include separate reading rooms for books, for journals, for indexes and abstracts, for reports, and for maps and microfiche, as well as a database access room and a photocopying room.

Editing/publication

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

Information Management Section

INFOTERRA

INFOTERRA, the Global Environmental Information Exchange Network designed by UNEP to stimulate and support the exchange of environmental information between partners, is operated at the national level by national focal points. This Center is designated as the INFOTERRA National Focal Point for Japan. As of March 1999, 178 countries were participating in INFOTERRA, and information sources registered in INFOTERRA numbered about 8000 (576 in Japan).

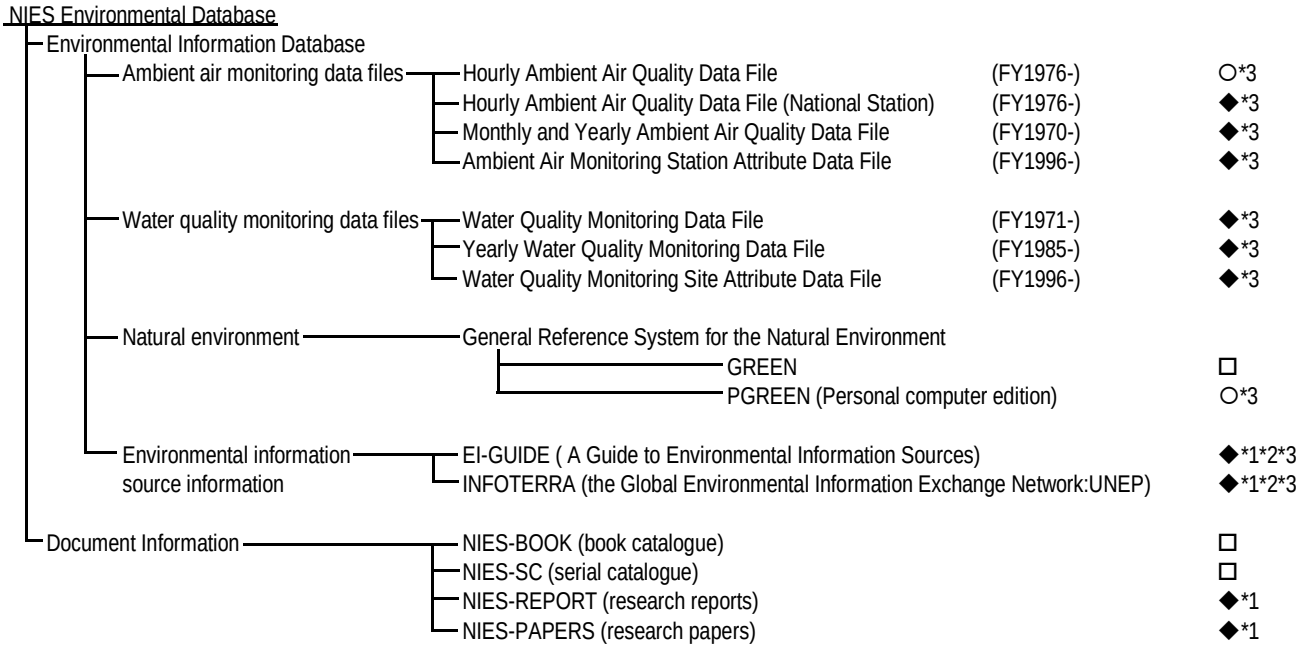
Management and operation of computer and related systems

A new computer system started operation in March 1997. The system is regarded as an integration of a general-purpose computer system and a supercomputer system to meet the increasing demand for computing resources and a multiplicity of processing uses. This UNIX-based computing environment consists of a comparatively large-scale supercomputer system (NEC SX-4/32 (32 CPU)) and various subsystems such as a scalar-computing server (IBM RS6000/SP2 (16 CPU)), database servers (3 sets of SUN Enterprise 2/1200 (Oracle7, SAS), and 2 sets of NEC Express 5800/160 Pro (Oracle7 Workgroup)), and file servers (a DEC Alpha Server 8400 5/440 (4 CPU), 2

sets of Alpha Server 4100 5/400, a SONY File Bank system, and a Peta Site system).

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

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

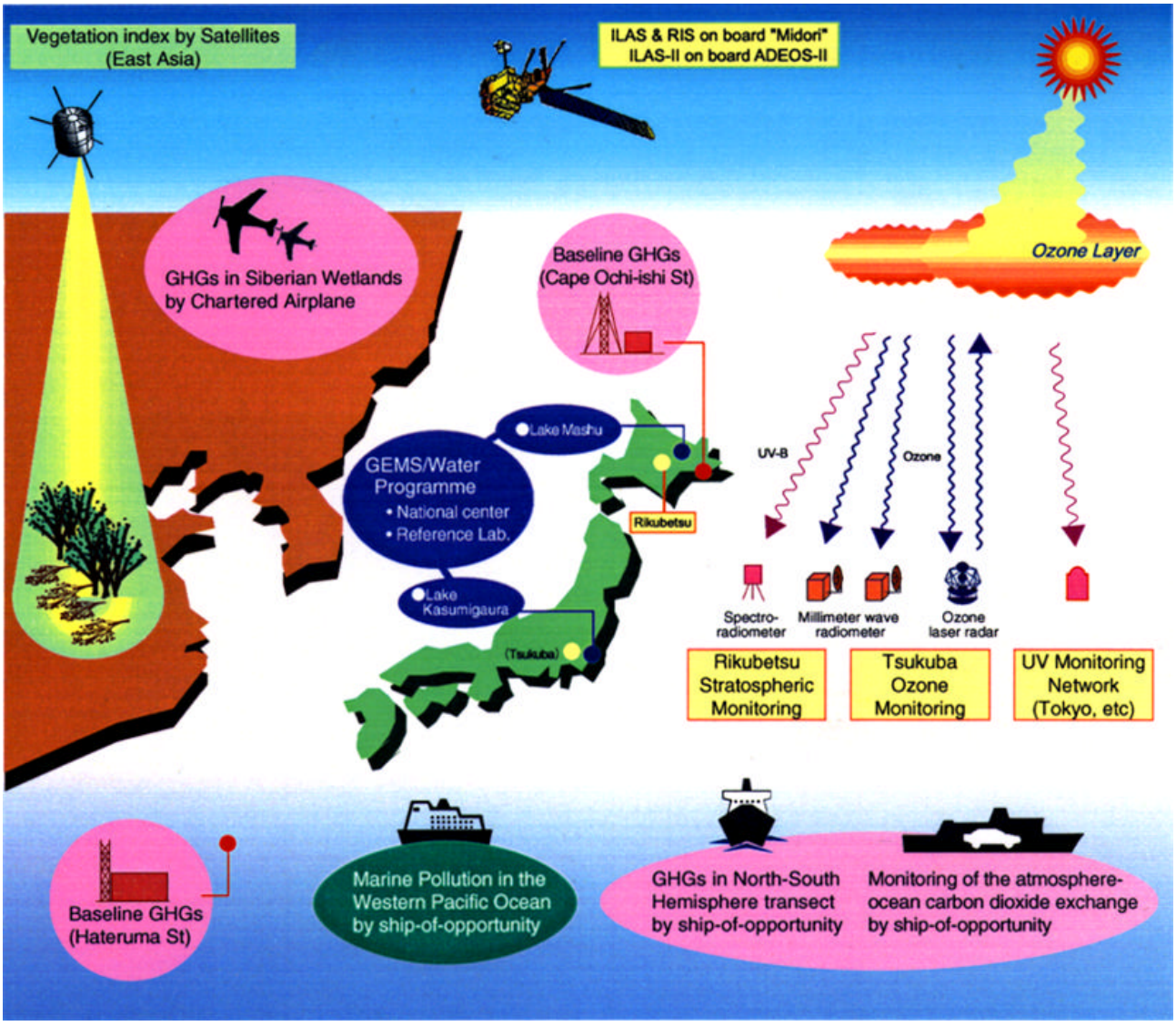


Availability Codes

◆ Provided to general public
○ Provided to administrative organizations, researchers, etc.
□ Restricted to use in NIES
*1 NIES World Wide Web Server (WWW)
*2 EICnet
*3 Provided by electronic media

Fig. 1
Composition of the NIES environmental database.

Center for Global Environmental Research



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

Integration of global environmental research

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 Department 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 using our supercomputer facilities, which are open to researchers at institutes and universities around the world; and 5) to conduct integrated research into policy options for coping with global environmental problems.

Enhancement of communication

CGER hosted several seminars, symposia and conferences on research into global environmental change in FY1998. Some, such as the annual Global Environment Tsukuba, brought together researchers and decision-makers with the general aim of enhancing communication. CGER also supported the efforts of groups seeking to organize workshops or symposia on specific research programs. In 1998, such groups included the "NIES Workshop on Information Based and Modeling for LUCC Studies in East Asia (LU/GEC)", the workshop "Environmental Change and Biodiversity", the lecture meeting "Impacts of Rising CO_2 and O_3 on Vegetation", the activities of IGBP sub-committees,"International Symposium on Research to Combat Desertification" and "Workshop on Regional Research Cooperation to Combat Desertification in Asia".

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 essential for progress in scientific understanding of global change. CGER set up the "Scientist Network on Indonesian Forest Fires" (SNIFF) in November 1997, —for information exchange among researchers and decision-makers dealing with those fires.

CGER is actively participating in the work of the Intergovernmental Panel on Climate Change (IPCC). IPCC has begun to prepare the Third Assessment Report for completion in February 2001 and decided on both a tentative table of contents and authorship at the 14th plenary session held in November 1998. The authors appointed to be in charge of the 2nd and 3rd working groups are from CGER. A special report on scenarios for emission of greenhouse gases is in progress; the Assessment Integrated Model of NIES was selected as the model on which to base and assess the emission gas scenarios.

Fig. 1
CGER's supercomputer.

Fig. 2
The 6th Supercomputer Research Workshop.

Coordinating supercomputer-aided research programs

In March 1997, CGER renewed the a supercomputer system to NEC SX-4/32 and in March 1999, added an ultra-high-speed function and large magnetic disk, which have greatly improved and facilitated research on global change (Fig. 1). An annual supercomputer activity report is published and the 6th Supercomputer Research Workshop was convened by CGER to disseminate advanced knowledge obtained by users of the supercomputer (Fig. 2).

Integrated research on policy options

A special research category in the Environment Agency's Global Environment Research Program, Integrated Research, is research directed towards actual decision-making processes through the development of conceptual models and the generation of data used widely in interdisciplinary research. Three research projects in this category were implemented in 1998: 1) Studies on Integrated Environmental-Economic Analysis toward a Sustainable Global Society; 2) Preliminary Study on Synthezation of Climate Models and Integrated Assessment Models for Global Warming Issues; and 3) Feasibility Study of the Impact of Indonesian Forest Fires on the Global Environment and Restoration of the Ecosystem.

Management of the global environmental 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 1998, collection of basic information about studies on sinks of greenhouse gases began, because it was accepted in the Kyoto Protocol, adopted in COP3 held in 1997, that carbon sequestration in land-use change and forestry should be taken into account. We have also collected socio-economic information and renewed a "meta-data database" to enable access to global environmental data, which have been changing rapidly due to the increasing use of Internet in recent years. Work on the "meta-data database" in FY 1997 concerned information about international research organizations, programmes and databases.

Regarding original databases, the IPCC scenario database of greenhouse gas emissions, a socio-economic database for predicting the future environment in the Asian region, was updated. An inventory of sources of SO_2 discharge in Korea, China and India, a basic database for elucidating long-range transboundary air pollution in East Asia, was also updated, as was a similar database on NO_x discharge in China and India. A data set from the project High Temporal-Spatial Resolution Marine Biogeochemical Monitoring from Ferries Tracks in the East Asian Marginal Seas ('96-'97), based on observations made by CGER/NIES, was arranged and processed. A CD-ROM containing data from observations made by CGER/NIES ('96-'97 Collective Volume)

during this project was published. Basic information on analytical methodology for remote-sensing data is being collected and made available for use in measuring the amounts of greenhouse gases removed by sinks such as forest trees and soil, as required by the Kyoto Protocol. Furthermore, a Material Flow Data Book was prepared to help understand the effects of export and import of natural resources on the global and Asian environment.

Global Resource Information Database (GRID)

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 1998, 135 data sets were distributed to users in and outside Japan in response to 65 requests. There were 18 inquiries, all of which were addressed, concerning the activities of GRID-Tsukuba and other GRID centers.

A new database, using data from the NOAA satellite , obtained via a receiving station in Bangkok, Thailand, was prepared for analysis of East Asian vegetation index data collected by CGER/NIES. Furthermore, 0.5 degree grid data on world solar radiation was arranged in a database for studies on sinks of greenhouse gases.

Global Environmental Monitoring

CGER has observed and recorded data on various global phenomena via long-term monitoring programs. These data are available through published data reports or data set files provided by international data networks in which CGER participates. The following 11 projects are presently coordinated by CGER.

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

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

Monitoring of UV-B

To elucidate the trend in urban ultraviolet-B (UV-B) intensity in solar radiation resulting from stratospheric ozone depletion, CGER installed a Brewer Spectrophotometer on top of a building in Tokyo. Monitoring has been conducted since November 1993. In 1998 CGER started a nationwide UV-monitoring network in collaboration with several universities and other institutions.

Stratospheric monitoring in northern Japan

To monitor the ozone layer over the northern part of Japan, the Rikubetsu Station for the Detection of Stratospheric Change was founded in Hokkaido in October 1997. NIES and the Solar-Terrestrial Environment Laboratory of Nagoya University agreed

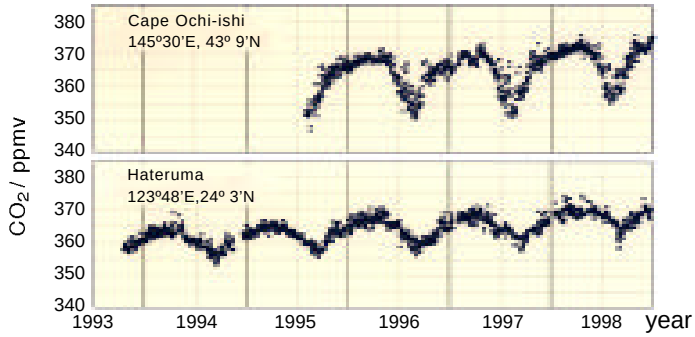


Fig. 3
CO_2 concn. Change in time at Hateruma and Cape Ochi-ishi.

to cooperate in monitoring ozone and related species. A millimeter-wave radiometer was installed in March 1999.

Japanese atmospheric monitoring stations (Hateruma Island and Cape Ochi-ishi)

The concentrations of greenhouse gases (GHGs) at these two stations are continuously monitored to understand trends in background air quality in Japan. Atmospheric data from the monitoring station on Hateruma, the southernmost inhabited island in Japan, should be representative of the air quality in southern Japan. Monitoring there started in October 1993. Similar data for northern Japan have been collected at the station at Cape Ochi-ishi, Hokkaido, since September 1995(Fig. 3).

Monitoring of GHGs over Siberia by Airplane

The boreal forest CO_2 sink and CH_4 emission from natural wetlands and natural gas mining are among the factors that govern variations in the carbon cycle in the northern hemisphere. Vertical concentration profiles of GHGs from 500 to 7,000 m in several areas of Siberia are obtained monthly by sampling from aircraft, followed by laboratory analysis in Japan. Monitoring has been carried out over Surgut in central western Siberia since 1993, over Yakutsk in eastern Siberia since 1996 at the same latitude (60°N), and over Novosibirsk (55°) N in southwestern Siberia since 1997. The seasonal amplitude of CO_2 variations over Siberia appears to be larger than that measured over the sea at the same latitude.

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

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

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

Invasion of CO_2 from the atmosphere to the ocean constitutes one of the most important sinks in global carbon cycling. For estimating the net rate of atmosphere-ocean CO_2 exchange, instruments were installed on a cargo ship sailing between Canada and

Japan. Partial pressure of CO_2 in air and the surface of the ocean is measured automatically. There is clearly invasion of CO_2 into the ocean in summer and evasion from the ocean in winter in the northern sub-arctic Pacific. In the mid-latitude Pacific, the ocean behaves as a sink of CO_2 throughout the year.

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

The cycles of chemical elements such as C, N, P and Si have changed from those in pre-industrial and pre-agricultural times. These changes are thought to have impacted on the oceans through marginal seas. CGER has been measuring temperature, salinity, pH, fluorescence, dissolved nutrients, chlorophyll a and pheopigments in the continuous water intake of the vessels "Sunflower2" (Osaka-Beppu) and "Ferry-Kuroshio" (Osaka-Naha) since March 1994. The monitoring system on the former ship was transferred to its successor "Sunflower Ivory" in 1997. The service of "Ferry-Kuroshio" stopped in March 1998 and CGER is planning to continue this mission from a container ship sailing between Japan and other Asian countries.

Mapping the vegetation index with NOAA satellite data

In order to monitor changes of vegetation and land cover in East Asia, Normalized Difference Vegetation Index (NDVI) mosaic images are composed from Advanced Very High Resolution Radiometer (AVHRR) data of NOAA satellites. In FY 1998, monthly NDVI mosaic images from January to December 1997 were produced from AVHRR data received by the two receiving stations, located at Tsukuba in Ibaraki Prefecture and Kuroshima in Okinawa Prefecture, respectively. Net Primary Production (NPP) values of vegetation were estimated by integrating monthly NDVI values over a year.

ILAS & RIS, ILAS-II data-handling facility

The ILAS & RIS data-handling facility (DHF) is used for re-processing data collected by the satellite-based sensor ILAS in order to retrieve atmospheric gas profiles in the polar ozone layer. Management of the ILAS & RIS DHF is the responsibility of CGER in cooperation with the Satellite Remote Sensing Research Team. The data products from the ILAS & RIS DHF have been used for atmospheric scientific research provided to general users via the Internet. Installation of the computer system for the data-handling facility for ILAS-II, which will be launched in 2000, was accomplished in FY 1998.

GEMS/Water Program

GEMS/Water is the Global Environmental Monitoring System for rivers and lakes, organized under UNEP and WHO. A network of 21 stations in Japan has been established for GEMS/Water PhaseII activities. In particular, Lakes Mashu and Kasumigaura have been registered as network sites. CGER is responsible for coordinating GEMS/Water data transmissions, etc., as the Japanese National Center (focal point). CGER also participates in an Analytical Quality Control (AQC) program by providing certified reference materials (CRMs/river sediment) to laboratories analyzing samples from GEMS/Water flux monitoring stations.

Environmental Training Institute

The National Environmental Training Institute (NETI) has provided training courses on administrative skills and analytical techniques in the environmental field to governmental staff since its foundation in 1973. The subjects of the courses have been modified and new courses added as governmental administrative strategies changed.

In FY1998, 20 administration, 9 laboratory analysis, 4 international cooperation courses and an international technical cooperation training course were provided (Table 1). There was one new course: Development of Experts in International Cooperation on the Environment(step 1), which aims to impart an understanding of environmental problems faced by most developing countries and to develop in trainees the ability to solve these problems in cooperation with people of those countries.

A total of 28,000 persons from a variety of organizations had completed their training by the end of March 1999. Seventy percent were from local governments, twenty percent from the central government, and the remainder from public corporations (Fig. 1). NETI also accepts trainees from overseas.

Last November, NETI held a seminar entitled Promotion of International Cooperation at the Local Governmental Level, about 60 highly ranking offcials participated. The seminar focused on the nature of global environmental issues and how local governments can work on them.

There are two new training courses for FY1999: Development of Experts in International Cooperation on the Environment(step 2), which is more practical than step 1 and Environmental Monitoring (dioxin-like compounds) Training Course .

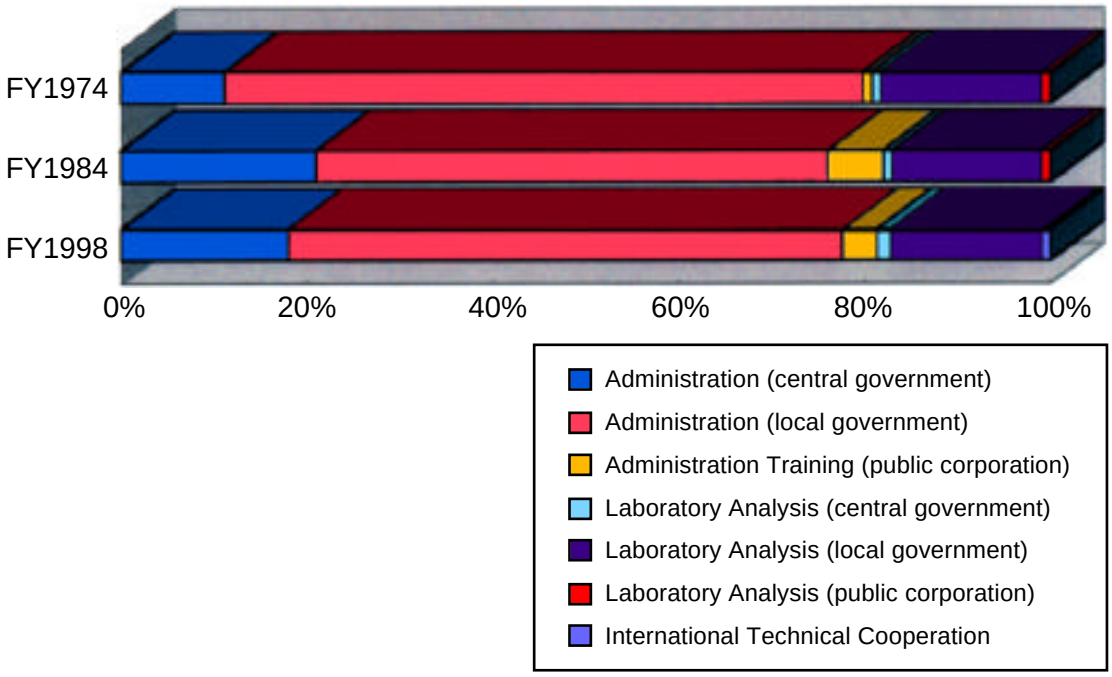


Fig. 1
Percentages of participants in the different courses over time. In the figure, participants in international cooperation training courses are combined with those in administration training courses.

Table 1 (FY1998)

Administration Training Courses

Course Name	Length (days)	Participants
Seminar for Environmental Policy Manager/Supervisor	5	40
Regional Environment (Environmental Management)	5	71
Environmental Impact Assessment (Administrative)	5	61
Environmental Impact Assessment (Technical)	8	39
Environmental Education (Administrative)	5	52
Environmental Education (Practical)	3	22
The Basic Environment Plan	5	70
Nature Conservation	6	57
Wildlife Conservation	5	50
Air Quality Conservation	6	90
Noise and Vibration Control	5	82
Water Quality Conservation	6	112
Environmental Conservation of Groundwater and Ground Subsidence	5	38
Environmental Information Management	8	30
Staff of the Environment Agency (Sub-Section Chief)	5	13
New Recruits of the Environment Agency (Class I)	8	16
New Recruits of the Environment Agency (Class II& III)	5	13
National Park Management	5	40
Newly Assigned Regional Environmental Intelligence Officers	4	10
Comprehensive Policy Formulation	56	3
Sub Total	—	909

Laboratory Analysis Training Courses

Course Name	Length (days)	Participants
Instrumental Analysis	13	44
Environmental Monitoring	8	27
Air Quality Analysis	13	32
Water Quality Analysis	13	42
Offensive Odor Analysis	5	4
Special Instrumental Analysis I (2 courses)	5	19
Special Instrumental Analysis II	5	5
Special Analytical Topics:		
Periphytic Algae	5	9
Plankton	5	16
Macrobenthic Invertebrates	5	13
Water Blooms	5	16
Special Analyses (2 courses)	20	2
Sub Total	—	229

International Cooperation Training Courses

Course Name	Length (days)	Participants
Global Environmental Conservation	8	59
Trainers for Overseas trainees	5	13
Introduction to International Environmental Cooperation (2 courses)	5	55
Development of Experts in International Cooperation on the Environment (step1)	12	9
Sub Total	—	136

International Technical Cooperation Training Course

Course Name	Length (days)	Participants
Environmental Monitoring (Water Quality)<JICA>	32	12
Grand Total	—	1,286

<Global Environment Research Projects>

Mechanisms of global warming caused by the increase of greenhouse gases, Nojiri, Y., 1990-1998

Depletion of the ozone layer, Nakane, H., 1996-1998

Acidic precipitation, Satake, K., 1996-1998

Role of ocean flux in variations of the global environment and marine pollution, Harashima, A., 1996-1998

Maintenance mechanisms of tropical forest ecosystems, Furukawa, A., 1996-1998

Internance collaborative studies for applying the Asian-Pacific Integrated Mobel (AIM) to assess global warming abatement policies with developing countries, Morita, T., 1997-1999

Risk perception and behaviors in relation to developmental level and quality of life (QOL) in the Asia/Pacific countries, Kabuto, M., 1997-1999

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

<Special Research Projects>

Methodology for quantification of environmental loads and their environmental impact assessment regarding transport systems and material cycle systems, Moriguchi, Y., 1996-1998

Bioremediation mechanisms for contaminated soil and groundwater, Yagi, O., 1996-1998

Biogeochemical cycles and self-purification in shallow coastal areas for preservation of the marine environment, Kohata, K., 1996-1998

Health risk assessment of exposure to extremely low frequency electromagnetic field, Nitta, H., 1997-1999

Origin and dynamics of recalcitrant organic matter in lake and its effects on lacustrine ecosystems and water quality, Imai, A., 1997-1999

Reproductive and developmental effects of hormone-like chemicals in the environment, Yonemoto, J., 1997-1999

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

Health risk assessment of exposure to extremely low frequency electromagnetic field, Nitta, H., 1997-1999

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

VOCs distribution and it's effects on urban air quality, Wakamatsu, S., 1998-2000

<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

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

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

<Others>

Development of bioeffect sensors for environmental chemicals, Mochitate, K., 1995-1999

Paleoenvironmental studies of Baikal sediment cores, Kawai, T., 1995-1999

Development of technology and methodology for automatic sampling and analysis of air toxic compounds, Tanabe, K., 1997-1999

International Workshop on Frontiers in Accelerator Mass Spectrometry

January 6-8, 1999
NIES,
Tsukuba,Japan

The International Workshop was held at Ohyama Memorial Hall of NEIS and the National Museum of Japanese History with 64 participants including 15 foreign researchers and 40 presentations. This workshop was held under a japan-UK Bilateral Science and Technology Cooperation program, supported by STA and JISTEC, and development of new techniques for ANS appliications in environmental reserches, including compound-specific ^{14}C analysis in environmental chemicals was the major topic. Two most important techniques for the compound-specific ^{14}C analysis are the gas ion source, which can produce C- ion from CO_2, and the preparative scale purification of environmental chemicals. The three leading groups on the development of the gas ion source, i.e. Oxford University, Woods Hole Oceanographic Institution (WHOI) and our institute (NIES), reported their present status. The NIES source and the Oxford source are based on the sputtering mechanism while that of WHOI is based on the piasma source combined with a charge-exchange device. By the comparison of the three reports, benefits and weak points of each system became evident and further research targets were identified. NIES and WHOI also presented potential and feasibility of the preparative scale purification of environmental chemicals by preparative capillary gas chromatograohy.

The 2nd International Symposium on CO_2 in the Oceans

January 18-22
Tsukuba Center for Institutes
Tsukuba,Japan

More than 200 scientists from 16 countries gathered in Tsukuba to discuss the role of the oceans in carbon cycling at the Second International Symposium on Carbon Dioxide (CO_2) in the Oceans. The advances since the first ocean CO_2 meeting, held in 1996 in Puerto Rico, have been spectacular. Among the themes discussed at this meeting were new assessments of oceanic CO_2 uptake, variability of CO_2 Parameters on seasonal-to-decadal time scales, blending of satellite and in-situ observations, and carbon sequestration. Presentations drew on both observations and modeling approaches to tackle these questions.

International Workshop on Information Bases and Modeling for Land Use and Cover Change Studies in East Asia

January 25-27
NIES,
Tsukuba,Japan

The concept of sustainable development became widespread following the United Nations Conference on Environment and Development (UNCED) in 1992. Land use/cover change indicates whether an area's development is sustainable or not and considered one of the most important research subjects in the international Human-Dimension Program for Global Change (IHDP) with regard to sustainable development in Asia.

This workshop, sponsored by the Environment Agency of Japan, was an important and timely opportunity for exchange and discussion of current ideas and scientific findings in the above studies. This workshop was aimed at contributing not onry to the betterment of our underetanding in land use/cover change in East Asia, in related information bases, ets., but also to the establishment of a research network in the region for future research collabboration. This workshop was great success with wonderful presentations and fruitful discussions for two and a half days.

Global Environment Tsukuba '98

-Carbon Dioxide and Vegetation: Advanced International Approaches for Evaluation of Vegetations as Sinks of CO_2 and Responses of Vegetation to CO_2-

March 18
NIES
Tsukuba, Japan

It becomes more important to evaluate vegetations as sinks of CO_2 after COP3 held in kyoto in 1997, because it was decided in COP3 that some kinds of vegetations are included as CO_2 sinks. Fourteen researches from Belgium, Canada New Zealand, Sweden, USA and Japan presented in 2 major subjects: evaluation of vegetations as sinks of CO_2 and the responses of vegetations to Co_2 through the FACE experiments.

The 1st japan-China Joint Workshop on the Marine Environment

March 18-19
Shiba Park Hotel,
Tokyo, Japan

Large rivers are thought to have great effects on the marine environment in the northwest Pacific Ocean, because those large rivers transfer a lot of nutrients and/or pollutants from lands to the ocean. there are large rivers as such the Hwang Ho River and the Yangtze River in China; therefore, a joint workshop between Japan and China was held at Tokiyo and supported by the Environment Agency of Japan. One of the main themes of the workshop is the planning and implementing the monitoring of northwest Pacific Ocean including the marginal seas, such as the East China Sea and the Japan Sea. NIES of Japan and State Oceanic Administration of China agreed upon the cooperative research on the isolated meso-cosm experiments and cooperative monitoring in the estuary of the Yangtze River and the East China sea.

NIES/CREST Workshop on Assessment of Health Risk pf Diozins

March 30
NIES,
Tsukuba, Japan

Some of the deleterious effects observed in wildlife have been attributed to endocrine disruptor, especially to some persistent organic chemicals, such as PCBs, DDT, dioxin and some pesticides. In addition to potential reproductive effects on wildlife, human health effects such as breast cancer and endometriosis in women, testicular and prostate cancer in men, reduced male fertility and decreased thyroid hormone in neonates, have increased in recent years.

The workshop was jointly supported by NIES and CREST/JST. More than 50 participants from Italy, USA, The Netherlands and Japan were gathered. Recent laboratory research results in NIES and in USA were presented as well as some field/epidemiological results from European countries. The workshop concluded with fruitful output such as future cooperative research plans.

COUNTRY
No. Title
Collaborating Institution
NIES Partner

AUSTRALIA
1. Biogeochemical studies on the trace elements in marine environments
Western Australian Marine Research Lab.
Environmental Chemistry Div.
2. Development of new methodologies to assess physiological effects of environmental pollutants
Dept. Biochemistry, Univ. Tasmania
Environmental Health Sciences Div.
3. Cooperative research on global environmental monitoring
CSIRO
Atmospheric Environment Div.
4. A comprehensive database of microbial diversity: cyanobacteria
University of NSW
Environmental Biology Div.
5. Trace characterization of organic/inorganic carbon in marine environment
WA. Marine. Res. Labs
Regional Environment Div.

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

CHINA
1. Advanced wastewater treatment processes for China
Research Institute for Environmental Engineering/Dept. Environmental Engineering, Tsinghua Univ.
Regional Environment Div.
2. Advanced sewage treatment processes by soil system applicable to China
Institute of Applied Ecology, Chinese Academy of Sciences
Regional Environment Div.
3. Development of wastewater and water resources treatment processes applicable to China
Chinese Research Academy of Environmental Sciences
Regional Environment Div.
4. Preparation and evaluation of environmental certified reference materials
China-Japan Friendship Environmental Protection Center
Environmental Chemistry Div.
5. Development of monitoring method and surveillance of dry deposition
China-Japan Friendship Environmental Protection Center
Atmospheric Environment Div.
6. International joint research project on health effects of environmental pollution and their prevention in China
Institute of Environmental Health and Engineering
Regional Environment Div.
7. Molecular epidemiological study on clarification of risk factors of the increased lung cancers in China
China Medical University
Regional Environment Div.
8. A study on the carrying capacity of specified region in East China Sea and the impacts of runoff on marine ecosystem
Department of International Cooperation State Oceanic Administration
Water and Soil Environment Div.
9. A study on the health effects of heavy metals in China
Environmental Medical Research Institute, Beijing Medical University
Environmental Health Sciences Div.
10. Research on the development of water pollution control techniques for the Taihu Lake in China by bio/ecoengineering
Chinese Research Academy of Environment Sciences
Water and Soil Environment Div.

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

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

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

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

KOREA
1. Aircraft and ground-based observations of acidic and/or oxidative pollution in East Asia
Environment Research Center, Korean Institute of Science and Technology
Global Environment Div.
2. Monitoring of ocean environmental parameters from a Japan-Korea ferry boat
Korea Ocean Research and Development Institute
Global Environment Div.
3. A joint-study on health effects of high-tech-related materials
Gyeong-Sang Natl. University
Regional Environment Div.
4. Cross-cultural comparison of landscape evaluation between Japanese and Korean
KyungPook University
Social and Environmental Systems Div.
5. Organotin pollution and “imposex” in sea snails in Korea
Yosu National University
Regional Environment Div.

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

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

RUSSIA
1. Research programs under the Baikal International Center for Ecological Research
Limnological Institute, Russian Academy of Sciences
Environmental Chemistry Div.
2. Airborne measurement of greenhouse gases over Siberia
Central Aerological Observatory
Center for Global Environmental Research
3. Modeling of methane emission rates from natural wetlands
Institute of Microbiology
Center for Global Environmental Research
4. Measurement of methane emission rates from permafrost areas
Permafrost Institute
Center for Global Environmental Research
5. 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. Evaluation of the role of the Far East Siberian forest in the global environment preservation
Yakutsk Biology Institute
Global Environment Div.

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

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

U. K.
1. Solubilization of toxic heavy metals from man-made objectives by acid rain
Dept. Earth Science, Univ. Sheffield
Regional Environment Div.

2. In vivo NMR spectroscopy method and its application to the field of environmental health
   Dept. Biochemistry, Univ. Cambridge
   Environmental Health Sciences Div.
3. Effects of environmental pollution on the metabolism of trace elements in man
   Rowett Research Institute
   Environmental Health Sciences Div.
4. Algae and Protozoa
   CCAP, Institute of Freshwater Ecology
   Environmental Biology Div.

U. S. A.
1. Preparation and evaluation of certified reference materials for marine monitoring
   NOAA
   Regional Environment Div.
2. Ecological and physiological aspects of methanotrophs
   Dept. Microbiology, Biochemistry and Molecular Biology, Univ. Maine
   Water and Soil Environment Div.
3. Development of bioremediation technologies for cleanup of contaminated soil
   Center for Environmental Biotechnology, Univ. Tennessee
   Water and Soil Environment Div.
4. Precise measurement of the greenhouse gases in the global baseline atmosphere
   Climate Monitoring and Diagnostics Lab, NOAA
   Center for Global Environmental Research
5. Direct impacts of global warming on morbidity in human community
   National Institute of Environmental Health Sciences
   Regional Environment Div.
6. Effects of logging on lakes ecosystems
   University of Alaska Fairbanks
   Regional Environment Div.
7. Human impacts on biodiversity and nutrient cycling in mire wetland
   Smithsonian Institute
   Environmental Biology Div.
8. Establishment of phytotron research network
   Duke University
   Environment Biology Div.

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

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

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

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

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Memorandum of Understanding between Changjiang Water Resources Commission, Ministry of Water Resources, People's Republic of China and National Institute for Environmental Studies, Japan for Collaborative Research on Developments of Monitoring Systems and Mathematical Management Model for Environments in River Catchment (1997)

Memorandum of Understanding between National Institute for Environmental Studies, Japan (NIES) and Chinese Research Academy of Environmental Sciences, People's Republic of China (CRAES) for Collaborative Research on Advanced Treatment of Domestic Wastewater (1997)

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).

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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>

Cameron, Owen Kyle, U.K., 1996. 11. 6~1998. 9. 3
Global Warming Mitigation Strategies; Government-Industry Responses (Morita, T.)

Dong, Xuhui, CHINA, 1997.7.2~
Co-operative study on the evaluation of emmission control on the indoor and outdoor environment in the model area—Establishment of measurement method for fluoride discharged from burning of coal and bio-briquette (Hatakeyama, S.)

Gao, Shidong, CHINA, 1997.4.1~1999.3.31
Co-operative study on the local production and spread of bio-briquetting technique—Selection of suitable biomass and binder for low ashcontent bio-briquette (Hatakeyama, S.)

Hooper, Rowan Earle, ENGLAND, 1997. 9. 1~1999. 1.31
Individual variation of parasite resistance in Calopterigid damselflies (Tsubaki, Y.)

Kang, Hyung Shin, KOREA, 1997. 6. 1~1998. 5. 31
Development of global warming scenarios in Korea (Morita, T.)

Lefevre, Franck, FRANCE, 1998. 7.20~1998. 9. 2
Comparison on atmospheric minor constituents erived by a 3-D chemical transport model (REPROBUS) with ILAS measurements (Sasano, Y.)

Murphy, Paulette, U.S.A., 1998.4.1~1999.3.31
Ocean carbon cycle in the North Pacific (Nojiri, Y)

Oshchepkov, Sergey Leonidovitch, BELARUS, 1998. 7. 3~
Optimal selection of measurement wavelength for optical atomospheric sensors (Sasano, Y.)

Pandey, Rahul, INDIA, 1998. 1. 7~1998. 4. 6
An International exchange study for developing AIM emission Model in India (Morita, T.)

Paulette, Murphy, U.S.A., 1998. 4. 1~1999. 3.31
Ocean carbon cycle study in the North Pacific (Nojiri, Y.)

Plaistow, Stewart John, U.K., 1997. 4. 1~1999. 3.30
The maintenance of alternative male phenotypes in the damselfly Mnais costalis: the role of stored energy reserves (Tsubaki, Y.)

Zeng, Yiqiang, CHINA, 1998.6.15~1999.3.31
Carbon and Sulfur isotope ratio of environmental samples in China (Mukai, H.)

<Regional Environment Division>

Anuradha, Dhanasekaran Cunnigaipur, INDIA, 1998.11. 2~
Gene expression in the lung following exposure to airborne toxic substances (Hirano, S.)

Cunnigaipur, Anuradha Dhanasekaran, INDIA, 1998. 10.2~1999.3.31
Specific gene expression in the lung following exposure to the air pollutamts (Hirano, S)

Dirk, Mathilde Hendrik Van Gogh, BELGIUM, 1998. 7.21~1998.9.5
Study on the design implementation of land transport systems to mitigate environmental burdens (Kondo, Y.)

Han, Jin-I, KOREA, 1998.5.18~1999.3.31
Toxicity assessment of environmental chemicals based on the expression of brain ankyrin and neurite extension in neuronal cells (Kunimoto, M)

He, Yao-Wu, CHINA, 1998.7.1~
Development of Recycling Treatment Technologies for Organic Wastes for the Controlling CH_4 and N_2O Emissions (Inamori, Y.)

Kim, Baik-Ho, KOREA, 1997. 4.17~
Relations between Aquatic Organism and Water Quality in Shallow Lake Kasumigaura (Takamura, N)

Kim, Han Soon, KOREA, 1998. 9.12~
Dynamics of phytoplankton community in a fish-free pond: seasonal and vertical distribution of chrysophytes (Takamura, N.)

Kim, Sook-Yang, KOREA, 1998. 4.1~1998.11.30
Distributions of photosynthetic pigments and its derivatives in sediment samples of Tokyo Bay (Kohata, K.)

Kong, Hai-Nan, CHINA, 1996. 7. 1~
Development of CH_4 and N_2O Emission Control Using Ecoengineering sysems such as Wetland, Soil Trench and Oxidation Pond (Inamori, Y.)

Lu, Xi-Wu, CHINA, 1998. 7. 1~
Development of Appropriate Wastewater and Sludge Treatment Technology for Controlling CH_4 and N_2O Emission (Inamori, Y)

Lybka, Krystyna, POLAND, 1998. 7.5~1998. 8.15
Physiological and biochemical effects of increased UV-B stresses on seedling of cereal plants (Nakajima, N.)

Piver, Warren, U.S.A., 1998. 9.1~1998.10.17
Impacts of global warming on human morbidity (Ando, M.)

Prabhakaran, Krishnan, INDIA, 1997. 1.13~
A study of stress induced by physical environments (Kabuto, M.)

Rai, Hakumat, GERMANY, 1998. 5.16~1998. 6.22
Synergistic effects of UV-radiation on ETS activity and the production of lipid,polysaccharide, and protein on freshwater algal communities of pond ecosystem in Japan (Kasai, F.)

Sarkar, Shubhashish, INDIA, 1997. 6. 3~
The role of zinc involved in the antioxidative mechanisms against oxidataive stress induced by environmental pollutants (Yonemoto, J.)

Wu, Xiao-Lei, CHINA, 1998.6.1~1998.11.30
Development of separating culturesystems spotlighted on effective specific microorganisms with low growthrate such as dephosphorizing bacteria (Inamori, Y)

Xie, Ping, CHINA, 1998.11.16~1998.12.30
Studies on the ecological system management in shallow lake in Yangtzu River basin-Control of eutrophication by the introduction of filter-feeding fish (Takamura, N.)

<Social and Environmental Systems Division>

Jung, Tae Yong, KOREA, 1998.8.1~1999.3.31
A study on the Korea-Japan collaboration to support East Asian environment conservation (Morita, T.)

Lee, Kee Cheol, KOREA, 1998. 6.15~1998. 8.14
Distribution of 8 sceneries and their structures in Japan (Aoki, Y.)

Rana, Ashish, INDIA, 1999.3.29~
Scenario analyses of Indian energy, economy and emissions based on a general equilibrium model (Morita, T.)

Welch, Eric W., U.S.A., 1998. 7.31~
Managerial and Policy Effects on Consumption Behavior of Organizations (Gotoh, S.)
Zhao, Jing Zhu, CHINA, 1999. 1.28~1999. 3.21
Studies on environmental assessment and its indicator for sustainable development (Morita, T.)

<Environmental Chemistry Division>

Chatterjee, Amit, INDIA, 1998. 6.10~
Studies on the Speciation of Arsenic in the Environment and its Efficient Removal Method (Shibata, Y.)
Kareev, Mikhail Sergeyevich, UZUBEKISTAN, 1998.11.25~
Studies on Intermediary Species in Atmosphere and Flames using Li+ ion attachment mass spectrometry (Fujii, T.)
Morgenroth, Gerhard, GERMANY, 1998.6.1~1998.7.12
^{14}C measurements in trace amounts of samples by accelerator mass spectrometry (Shibata, Y)
Sablier, Michel Claude, FRANCE, 1999. 2.19~1999. 3.31
Studies on Intermediary Species in Atmosphere and Flames (Fujii, T.)
Suliman, Fakhr Eldin Osman, SUDAN, 1998. 1.26~1999. 1.15
Development of monitoring system for volatile organic compounds (Soma, Y.)
Sundram, Arulmozhiraja, INDIA, 1997. 9.11~
Structure, energy and reaction of Dioxin. (Fujii, T.)

<Environmental Health Sciences Division>

Cherian, M. George, CANADA, 1998. 3. 5~
Significance of Heavy-metal binding proteins in detoxification of heavy metals (Tohyama, C.)
Jana, Nihar R., INDIA, 1997. 6.15~1998.12.31
Mechanism of toxicity of environmental endocrine disruptors in the male reproductive organs (Tohyama, C.)
Molotkov, Andrew O., RUSSIA, 1997. 2.24~1999. 2.23
Toxicological role of metallothionein in the nucleus (Satoh, M.)
Zhang, Baoxu, CHINA, 1996. 7. 1~1999. 3.31
The combined effects of ultraviolet irradiation and toxic chemicals on the skin tumorigenesis: Role of oxidative stress (Satoh, M.)

<Atmospheric Environmental Division>

Kournossenko, Alexei, RUSSIA, 1998.11.10~1999. 3.31
Effects of polar-midlatitude interaction on ozone trends (Nakane, H..)
Lukyanov, Alexander, RUSSIA, 1997. 7. 1~1999. 3.31
Study on the Arctic ozone depletion mechanisms using the chemical transport model (Nakane, H.)
Namboothiri, Parameswaran, INDIA, 1996. 8. 1 ~1999. 3.31
Observational studies on the coupling of dynamical and chemical processes in the middle atmosphere (Sugimoto, N.)
Peter, Voelger, GERMANY, 1998. 8.31~
Relevance of multiple scattering in space lidar measurements of clouds and aerosols (Sugimoto, N.)
Song, Yongchen, CHINA, 1998. 4. 1~
Study on polar-midlatitude interactions and ozone variability (Nakane, H.)
Subramanian, Sivanesan, INDIA, 1998. 2. 1~
Studies on photooxidation processes of the atmospheric minor constituents by using a $6m^3$ photochemical chamber (Washida, N.)
Zils, Regis, FRANCE, 1996.12.13 ~1998.12.12
Studies on the ozone depletion impact by heterogeneous processes (Washida, N.)

<Water and Soil Environment Division>

Belova, Svetlana E., RUSSIA, 1998. 10. 6~
Biodiversity of microorganisms responsible methane formation in the West Siberia wet land (Uchiyama, H.)
Ding, Guo-Ji, CHINA, 1998.12.24~1999.3.31
Research on the behavior of attached micro-animals in river treatment systems using aquatic plant (Xu, Kai-Qin)
Jiao, Nianzhi, CHINA, 1997.11. 1~
Biodiversity of picoplankton in East China Sea (Watanabe, M.)
Li, Lin, CHINA, 1998. 7. 1~
Analysis on land use change at the lower Yangtze River Basin due to industrialization and urbanization (Otsubo, K.)
Noel, F-C Mary-Helene, FRANCE, 1996. 4.22~1998. 4. 6
The role of Water/sediment interaction as a component of marginal sea ecosystem. (Watanabe, M.)
Pan, Jianming, CHINA, 1998. 7. 1~1999. 3.30
Biogeochemical process in East China Sea (Watanabe, M.)
Wang, Qinxue, CHINA, 1998. 7. 1~
Digital database for diagnostic analysis of environment in Northern and Northeastern parts of China (Otsubo, K.)
Wang, Quan, CHINA, 1997. 9. 1~1999. 3.30
Estimation of environmental load from land to East China Sea (Watanabe, M.)
Zhang, Jinsheng, CHINA, 1998. 9.21~1998.10.30
Geomorphic and hydrological network analysis of the Changjiang River catchment (Murakami, S.)

<Environmental Biology Division>

Gontcharov, Andrei A., RUSSIA, 1997.11. 1~
Studies on species diversity of microalgae based on reproductive isolation mechanisms (Watanabe, M.M.)
Hu, Zengyu, CHINA, 1999. 3. 1~1999. 3.30
Molecular phylogeny of filamentous green algae (Watanabe, M.M.)
Robertson, Bronwyn R., AUSTRALIA, 1998. 6. 1~
Molecular taxonomy and phylogeny of cyanobacteria as a model for evaluating biodiversity (Watanabe, M.M.)
Wichien, Yongmani, VIET NAM, 1999. 2.25~1999. 3.26
Mass culture and toxin production of toxic cyanobacteria (Watanabe, M.M.)

<Center For Global Environmental Research>

Wang, Qing Yao, CHINA, 1998.5.18~1999.3.31
Effects of global warming on vegetation and its conservation (Shimizu, H.)

<Environmental Training Institute>

Zhao, Xiang Dong, China, 1998.3.31~1998.7.25
Environmental training method (Sakou, T.)

Adachi, T., Hirayama, K. (*1) (*1Kumamoto Univ.) (1998)
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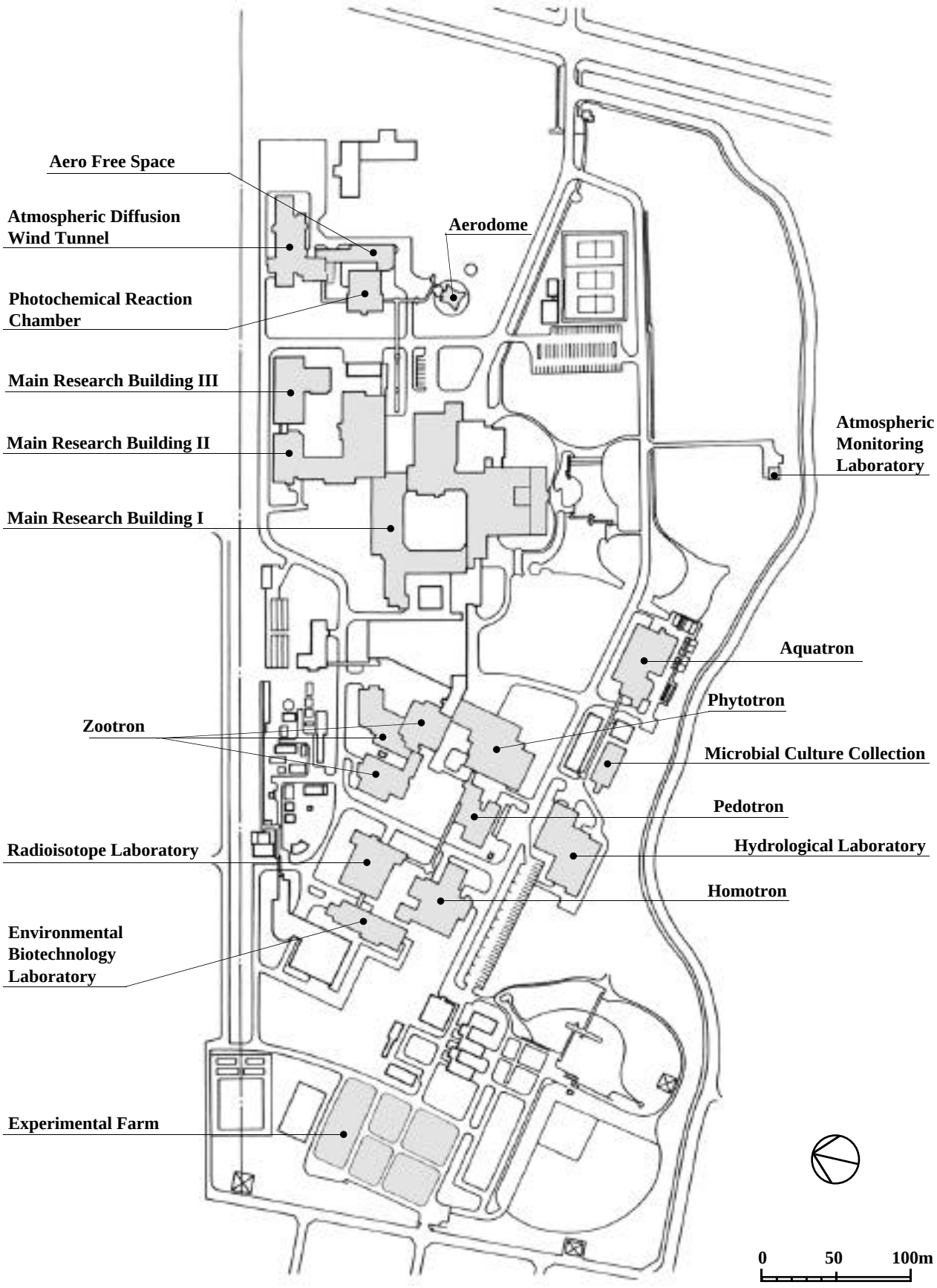
Aero Free Space
Atmospheric Diffusion Wind Tunnel
Aerodome
Photochemical Reaction Chamber
Main Research Building III
Main Research Building II
Atmospheric Monitoring Laboratory
Main Research Building I
Aquatron
Phytotron
Zootron
Microbial Culture Collection
Pedotron
Radioisotope Laboratory
Hydrological Laboratory
Homotron
Environmental Biotechnology Laboratory
Experimental Farm
0
50
100m

Aerodome
The aerodome is a facility both for remote monitoring of pollutant particles in the atmosphere (via a large-scale laser radar) and for study of the formation of secondary particulates from gaseous primary pollutants. The laser radar can scan rapidly and sensitively, with computer-controlled pointing, both tropospheric and stratospheric aerosols at any angle above the horizon. The 4-m^3 aerosol chamber can be evacuated to 10^{-5} Torr.

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

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

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

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

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

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

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

Global Environmental Monitoring Stations (Hateruma and Cape Ochi-ishi)
These monitoring stations were set up mainly to monitor long-term changes in the baseline levels of global-warming gases at sites where the effect of urban air pollution is virtually negligible. Hateruma Station is located in Okinawa Prefecture, on the eastern edge of Hateruma Island, the nation's southernmost inhabited island. This site is suited for monitoring the baseline atmosphere over the subtropical Pacific Ocean. Cape Ochi-ishi Station is located in Hokkaido Prefecture, at the tip of Cape Ochi-ishi, which is located at the foot of the Nemuro Peninsula. This site is suited for monitoring the baseline atmosphere over the Pacific Ocean in summer and over Siberia in winter.

These stations are automated systems for high-precision monitoring of global-warming gases and other atmospheric species; human attendance is not required.

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

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

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

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

Table of Analytical Instrumentation in Main Research Building I

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

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

Main Research Building II

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

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

2) Preservation Laboratory

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

Main Research Building III

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

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

2) Tandem Mass Spectrometer (Tandem-MS)

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

3) Accelerator Mass Spectrometer (AMS)

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

4) Hazardous Chemicals Area

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

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

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

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

The millimeter-wave spectrometer is widely and extensively used in astronomical measurements of gaseous molecules in space. Ozone molecules in the stratosphere and mesosphere radiate millimeter-range radio waves. The spectrometer system was completed in October 1995, and since then has continuously

monitored the vertical distribution of ozone (35~75 km altitude), except on rainy or heavily overcast days.

7) Eco-Office

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

8) Reception and Processing Facility for NOAA Satellite Data

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

9) Information Processing Center for GRID-Tsukuba

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

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

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

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

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

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

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

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

Present Number of Personnel

Director General	1
Deputy Director General	1
Research Coordinators	5
General Affairs Division	36
Global Environment Division	20
Regional Environment Division	47
Social and Environmental Systems Division	15
Environmental Chemistry Division	16
Environmental Health Sciences Division	17
Atmospheric Environment Division	20
Water and Soil Environment Division	19
Environmental Biology Division	16
Environmental Information Center	18
Center for Global Environmental Research	8
Environmental Training Institute	18
Total	257

Field of Expertise

Basic Sciences	85
Engineering	45
Agricultural Sciences	22
Medical Science	15
Pharmacology	8
Fisheries Science	3
Economics	2
Total	180

Division

Section/Team	Position	Staff Member	Extension	E-mail (@nies.go.jp)
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(∗) Multiple roles

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(∗)	HARASHIMA, Akira	2508	harashim
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(∗)	MACHIDA, Toshinobu	2525	tmachida
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(∗)	MORITA, Tsuneyuki	2541	t-morita
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(∗)	NOJIRI, Yukihiro	2499	nojiri
(∗)	OTSUBO, Kuninori	2417	kuninori
(∗)	SASANO, Yasuhiro	2444	sasano
(∗)	SHIBATA, Yasuyuki	2450	yshibata
(∗)	TAMURA, Masayuki	2479	m-tamura
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Professor	SHINOMIYA, Miho		

(∗) Multiple roles

ADEOS	Advanced Earth Observing Satellite
AIM	Asian-Pacific Integrated Model
AMS	accerelator mass spectrometry
APARE	East Asia/North Pacific Regional Experiment
APN	Asia-Pacific Network for Global Change Research
ARD	Aforestation, Reforestation and Deforestation
AVHRR	Advanced Very High Resolution Radiometer
CCSR	Center for Climate System Research
CDM	Clean Development Mechanism
CGER	Center for Global Environmental Research
CRA	comparative risk assessment
CRM	certified reference material
CTM	Chemical transport model
DE	diesel exhaust
DEM	digital elevation model
DEP	diesel exhaust particulates
DHF	Data Handling Facility
DHT	Dihydrotestosterone
ECG	electrocardiogram
ELISE	Experimental Lidar In Space Equipment
FA	fluctuating asymmetry
FAO	Food and Agriculture Organization of the United Nations
GC	gas chromatography
GC/MS	gas chromatography/mass spectrometry
GCM	general circulation model
GEMS/Water	Global Environmental Monitoring System/ Assessment of Freshwater Quality
GIS	geographical information system
GRID	Global Resource Information Database
HDP	Human Dimensions of Global Environment Change Program
HPLC	high performance liquid chromatography
HRP	horse-radish peroxidase
ICP-MS	inductively coupled plasma-mass spectrometry
IGBP	International Geosphere Biosphere Programme
IHDP	International Human Dimension Program
IL	interleukin
ILAS	Improved Limb Atmospheric Spectrometer
IPCC	Intergovernmental Panel on Climate Change
ISPC	International Scientific Program Committee
IT	International Transformation
LAN	Local Area Network
LCA	life cycle assessment
LCI	life cycle inventory
LCIA	life cycle impacts assessment
LU/GEC	Land Use for Global Environmental Conservation
LUCC	Land Use/Cover Change
MDS	Mission Demonstration test Satellite
NAT	nitric acid trihydrate
NDSC	Network for the Detection of Stratospheric Change
NOAA	National Oceanic and Atmospheric Administration
OVA	ove-albumin
PEACAMPOT	Perturbation by the East Asia Continental Air Mass to the Pacific Oceanic Troposphere
PG	prostaglandin
PM2.5	particle matters less than 2.5μm
PSC	polar stratospheric clouds
RIS	Retroreflector In Space
T3	Triiodo thyronine
T4	Thyroxine
TBT	tributyl tin
TCDD	2,3,7,8-tetrachlorodibenzo-*p*-dioxin
THESEO	Third European Stratospheric Experiments on Ozone
TPT	triphenyl tin
TSH	Thyroid stimulating hormone
UN	United Nations
UNEP	United Nations Environment Programme
WHO	World Health Organization
WWW	World Wide Web

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