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NIES Annual Report 2005

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National Institute for Environmental Studies
http://www.nies.go.jp/

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Foreword

This annual report is an official record of research activities at the National Institute for Environmental Studies (NIES) for the 2004 fiscal year (April 2004 to March 2005).

Throughout the year, several international cooperative efforts that relate to our work at NIES have met with epoch-making success. Following Russia's ratification, the Kyoto Protocol came into force in February 2005, eight years after its adoption at the Third Conference of the Parties (COP3) in 1997. Our Institute has continuously supported this protocol. In collaboration with many institutions in Japan and around the world, we are engaged in scientific research that will lead to the solving or mitigation of global warming. The 10-year program of the Global Earth Observation System of Systems (GEOSS) was finalized in February 2005, and it was decided that NIES, in cooperation with the Ministry of the Environment, will serve as Japan's principal institution for observing climate change and its impact. Furthermore, NIES will contribute to the 3R Initiative, which aims to create a sound material-cycle society through "reducing, reusing, and recycling".

Our research activities have covered a wide range of environmental issues at the local, national, regional, and global levels. As we completed the fourth year of our 5-year Mid-term Research Program, our efforts were primarily focused on reaching the goals of our planned research projects, including the six Special Priority Research Projects. The intermediate evaluation of these six projects and all other research activities conducted by our six Research Divisions, two Policy-Response Research Centers, and three Centers for Research Fundamentals resulted in an A grading. These impressive achievements were made possible through the painstaking efforts of our staff in collaboration with a large number of Japanese and international research organizations.

My sincere hope is that the readers of this report will familiarize themselves with our Institute and comment on our activities. We will use your opinions to further advance our work in the area of environmental research.

Ryutaro Ohtsuka
President
National Institute for Environmental Studies (NIES)

Contents

During the 1950s and 1960s, Japan experienced serious environmental pollution problems that accompanied rapid economic growth. In 1971, the Environment Agency was established within the Japanese Government to develop measures to counteract serious environmental pollution problems such as Minamata disease, caused by poisoning with organic mercury in factory wastewaters, and chronic bronchitis and asthma, caused by sulfur oxides emitted from factories in large industrial complexes. Because the promotion of basic research on environmental sciences was essential and had the potential to 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. NIES is the sole national institute for comprehensive research in the environmental sciences.

Researchers at NIES are skilled in various specialties, such as physics, chemistry, biology, health sciences, engineering, agricultural and fisheries sciences, law, and economics. 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 such as the Research Station for Reservation and Enhancement of the Water Environment, near the shore of Lake Kasumigaura, the Okunikkou Field Research Station, and the GHG Monitoring Stations in Hateruma and Cape Ochi-ishi.

Over the last 2 decades, rapid technological progress, structural changes in industry, and lifestyle changes 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 deposition, destruction of tropical rain forests, and desertification have recently given rise to deep concern worldwide. NIES underwent a major reorganization on 1 July 1990 to enable it to conduct more intensive research on both conservation of the natural environment and global environmental changes and their effects. The research functions of the new organization are conducted within 2 project research divisions, 6 fundamental research divisions, and the Center for Global Environmental Research. The Principal Research Coordinator, the General Affairs Division, and the Environmental Information Center facilitate the research activities. The Environmental Information Center has the additional functions of preparing and providing access to both research publications and environment-related databases. In January 2001, in the context of reorganization of the Japanese Government, the Environment Agency was promoted to Ministry of the Environment. At the same time, NIES established a Waste Management Research Division to conduct waste management research.

In April 2001, NIES was reborn as an Independent Administrative Institution. The change from government institute to new independent status has allowed us more flexibility in our operations, thus enabling us to provide better services to society.
NIES has prepared a medium-term plan that sets out our 5-year work goals, corresponding to the medium-term objectives of Ministry of the Environment. NIES hopes to obtain the understanding and support of the public by articulating its research orientations and objectives, and will disseminate the results of its research widely. Since the change, the new NIES has been very active in carrying out new research

projects and establishing new research buildings and facilities.

As of the end FY 2004, the total number of NIES regular permanent personnel was 275(6 foreigners included, Table 1). In FY 2004, NIES invited 310 scientists(7 foreigners included) to perform research programs as guest researchers and another 358 researchers (73 foreigners included) as NIES fellows. This involved collaboration between the researchers and junior visiting researchers, who joined in NIES's research activities. The total budget for FY2004 was 13,342 million yen (Table 2).

Table 1
Number of Permanent Personnel

Research	201	73.1%
Support & Management	51	18.5%
Env. Information Center	13	4.7%
Center for Global Env. Research	10	3.6%
Total	275	100%

(as of FY2004)

Table 2
Budget for Medium-Term Plan of NIES

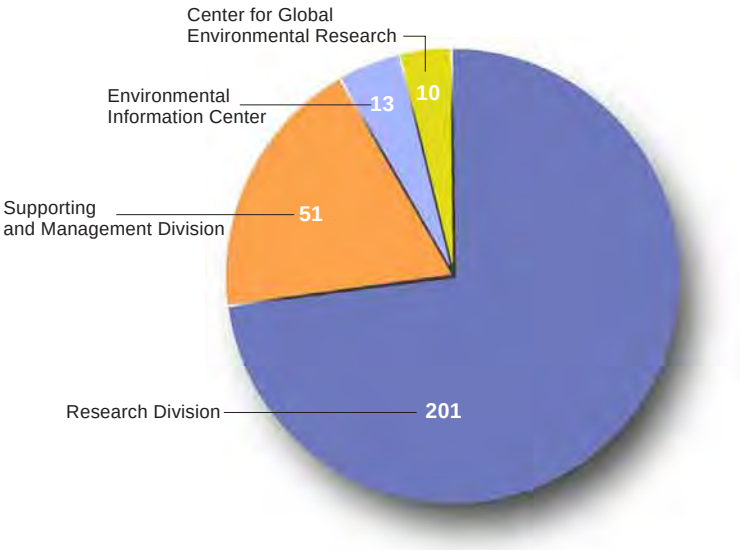
	Category	2001-05 Budget(5years)		Fiscal 2004 Budget	
		million $	million ¥	million $	million ¥
Revenues	Grant for Operating Costs	444	48,849	84	9,254
	Subsidies for Facilities	28	3,093	4	415
	Loan Without Interest	17	1,850	0	
	Commissioned Work	160	17,576	33	3,673
	Total	649	71,368	121	13,342
Expenditures	Project Costs	290	31,873	54	5,933
	for Special Priority Research Projects	64	7,050	6	681
	for Policy-Response Research Areas	37	4,109	5	578
	for Environmental Information	19	2,132	3	358
	Facility improvements	34	3,709	4	415
	Expenses for Commissioned Work	160	17,576	33	3,673
	Personal	132	14,545	26	2,857
	Redemption Expenses	11	1,234		
	General Administrative Expenses	22	2,431	4	464
	Total	649	71,368	121	13,342

Note:The budget for each annual work plan will be requested and decided each fiscal year, based on the Medium-Term Plan.
$1=¥110

Budget

Number of Permanent Staff

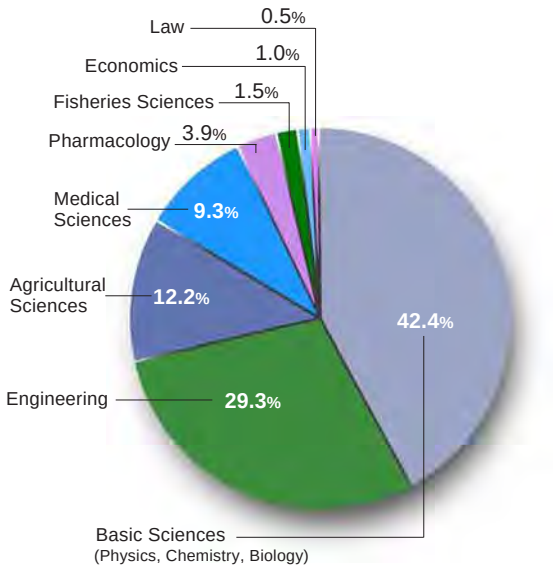
275



Fields of Expertise

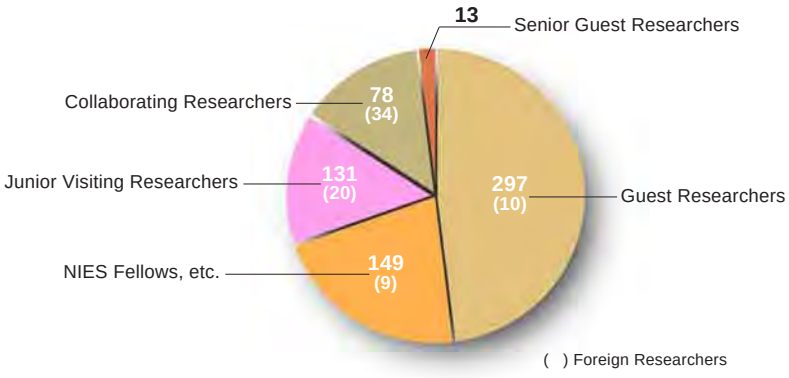
Researchers holding doctorates

91.2%



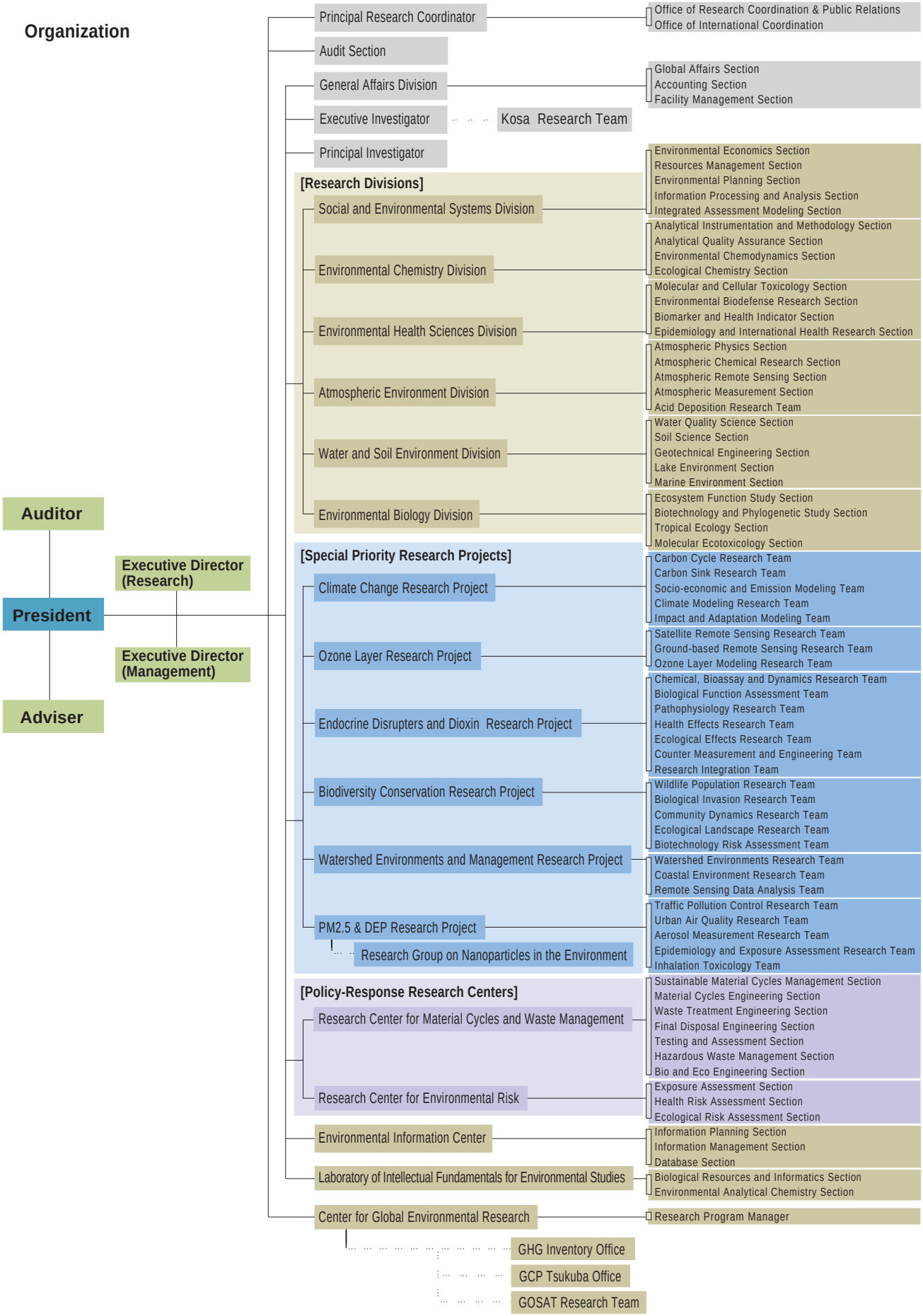
Number of Visiting Researchers

668(73)

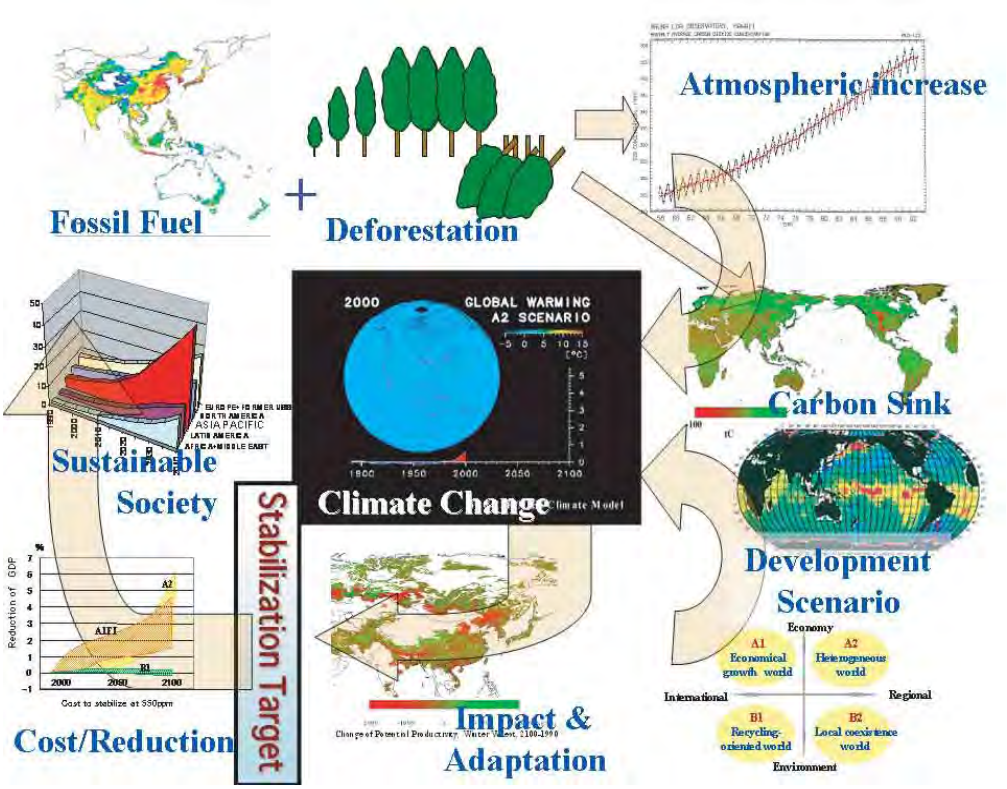


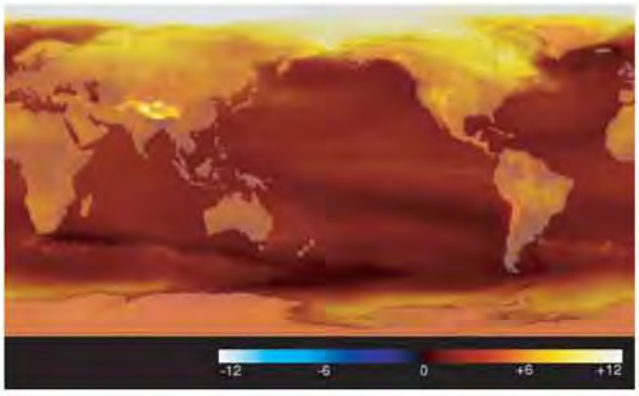
( ) Foreign Researchers

Organization



Climate Change Research Project





Simulated annual mean temperature rise in late 21st century relative to late 20th century

Sub-project on carbon cycle research

This sub-project was initiated to determine the patterns and driving forces of the carbon cycle among anthropogenic sources and the pools of atmospheric, biosphere, and oceanic carbon. The two research teams involved in this sub-project are the **Carbon Cycle Research Team** and the **Carbon Sink Assessment Team**. This year we are reporting mainly on our atmospheric observations and giving brief reports on our studies of forest carbon cycles.

Background and objectives

Nowadays, it is widely known that we have changed, and will continue to change, the Earth's climate system by greenhouse gas emissions through fossil fuel consumption and by deforestation. Analysis of the carbon cycle between the atmosphere, biosphere, and ocean is one of the key approaches to predicting future greenhouse gas concentrations and developing strategies to stabilize greenhouse gas concentrations in the atmosphere. Another approach is joint model studies that involve the prediction of climate change under different emission scenarios, the assessment of impacts on the basis of these predictions, and socioeconomic analyses to identify the most effective strategies for a sustainable society.

Observation of the atmospheric CO_2 cycle using oxygen concentration and carbon isotope ratio

In this study we are observing CO_2 and other targeted tracers to investigate the CO_2 cycle. In particular, for a long time we have been monitoring oxygen and carbon isotope ratios at two monitoring stations. Knowledge of the oxygen concentration can be used to constrain global CO_2 budgets, because atmospheric O_2 change is determined mainly by O_2 consumption through fossil fuel burning and O_2 release from the terrestrial biosphere in association with CO_2 uptake. Therefore, terrestrial CO_2 uptake is simply calculated from the difference between the observed decrease in atmospheric O_2 and the O_2 consumption by fossil fuel burning. To determine atmospheric O_2 and isotope changes, we have been collecting air samples at Hagerman Island (HAT, lat 24˚3´N, long 123˚49´E) since July 1997 and at Cape Ochi-ashy (COI, lat 43˚10´N, long 145°30´E) since December 1998.

Figure 1 shows the observed O_2/N_2 ratios and CO_2 mole fractions at HAT and COI, together with smooth-curve fits. From the smooth curve fits we calculated the annual mean O_2/N_2 ratio and CO_2 mole fraction. Figure 2 shows the relationship between average changes in the O_2/N_2 ratio and CO_2 concentration, as calculated from HAT and COI data. Each solid circle represents the annual average relative to the annual average at HAT in 1998. The average changes in the observed O_2/N_2 and CO_2 during the 6-year period 1998-2004 were -112 ± 2 per meg (-23.5 ± 0.3 ppm) and 10.4 ± 0.1 ppm, respectively. The broken line indicates the effects of fossil fuel combustion and cement manufacturing on atmospheric O_2/N_2 and CO_2 during the 6-year period. The average fossil carbon emission for the 6-year period was 6.8 Pg y^{-1}. The partitioning of the fossil carbon uptake between terrestrial biosphere and ocean is shown graphically in Figure 2: the horizontal arrow indicates oceanic uptake of 2.0 ± 0.5 Pg C y^{-1} and the arrow with a slope of -1.1 mol/mol, which is the O_2:C exchange ratio for

photosynthesis and respiration, indicates terrestrial uptake of 1.1 ± 0.6 Pg C y^{-1}. Recent studies suggest that the ocean is currently a significant net source of atmospheric O_2. Therefore, our estimates of the terrestrial and oceanic uptakes shown above may correspond to the upper and lower limits of these uptakes, respectively.

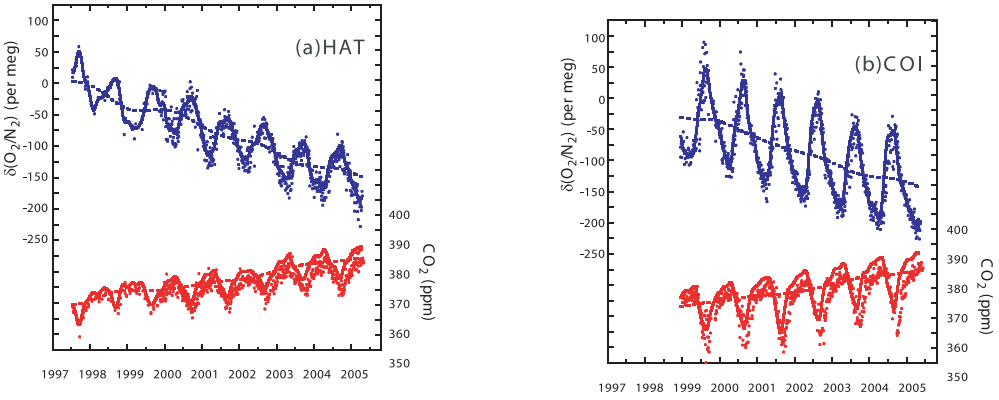


Fig. 1
Time series of O_2/N_2 ratio (blue) and CO_2 mole fraction (red) observed at (a) HAT and (b) COI. Solid lines indicate smooth-curve fits and broken lines are long-term trends.

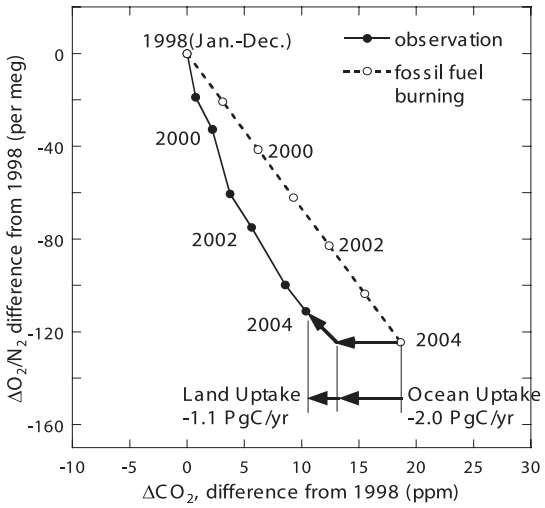


Fig. 2
Relationships between average changes in atmospheric CO_2 concentration and O_2/N_2 at HAT and COI. Broken line indicates the effect of fossil fuel combustion on atmospheric O_2/N_2 and CO_2. Solid arrows represent the partitioning of fossil CO_2 uptake between the terrestrial biosphere and the ocean.

To improve our understanding of the differences in CO_2 behavior between the planetary boundary layer (PBL) and the free troposphere (FT), we have been conducting CO_2 measurements using a small aircraft and a tower in a forest area in West Siberia. CO_2 mixing ratios are measured continuously from the 90-m-high radio communications tower located in the village of Berezorechka (lat 56˚10´N, long 84˚20´E). We developed a small CO_2 measurement device that works on the principle of single-cell NDIR (nondispersive infrared analyzer) (LI-800, LI-COR). It is equipped with flow and

pressure regulation systems and was installed in a small An-2 aircraft. The aircraft ascends to 2 or 3 km above the Berezorechka tower and then descends to 0.15 km to obtain a vertical profile of the CO_2 mixing ratio. Routine aircraft measurement is conducted in the afternoons 2 to 4 times a month. We have recorded more than 120 profiles since October 2001. Intensive flights to measure diurnal variations in the vertical profile of the CO_2 mixing ratio were conducted on 5 days in 2002, 6 days in 2003, and 4 days in 2004.

CO_2 mixing ratios are almost constant, or slightly higher in lower altitudes, in winter. In summer there are large day-to-day variations in both the absolute CO_2 mixing ratio and the vertical CO_2 stratification; these variations are well correlated with temperature and humidity profiles. To compare the temporal CO_2 variations in the PBL and the FT, we defined the PBL height from the vertical profiles of CO_2, temperature, and humidity. CO_2 mixing ratios were averaged for each layer. CO_2 values in the PBL were 10 ppm lower than those in the FT in summer and 3 or 4 ppm higher in winter. The peak-to-peak amplitude of the seasonal variation was more than twice as great in the PBL (36.9 ppm) than in the FT (15.7 ppm). The annual mean CO_2 mixing ratio in the PBL was 2 ppm higher than in the FT, mainly because of the rectifier effect.

Stable isotope ratios of atmospheric CO_2 have been used as powerful tools in carbon cycle studies. In this study program, we are focusing on the dynamics of the carbon stable isotope ratio of atmospheric CO_2 in the atmospheric boundary layer over forests in the continental interior. Regular monitoring of the profiles of the carbon stable isotope ratio within and over the atmospheric boundary layer will provide useful information for linking surface ecosystem isotopic exchange with atmospheric tracer transport models. We have developed a special sampling system (Fig. 3) that has been optimized for air sampling using small aircraft. It was used successfully in test sampling over a boreal forest in west Siberia in August 2004.

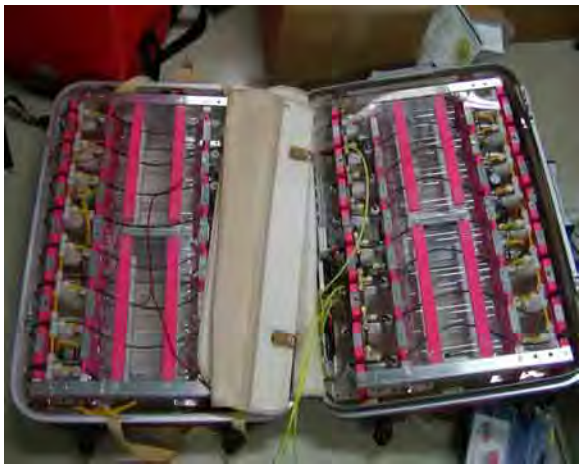


Fig. 3
System optimized for air sampling from small aircraft.

In a 50-year-old larch forest at the Tomakomai Flux Research Site in Tomakomai, Hokkaido, we partitioned the components of CO_2 flux by using multichannel automated chamber systems. In 2003, annual soil-CO_2 efflux was averaged at 9.59 t C ha^{-1}; heterotrophic respiration was about 5.47 t C ha^{-1} (accounting for about 57%

of the soil-CO_2 efflux); net annual CO_2 exchange in the understory vegetation was about -0.39 t C ha^{-1}; annual aboveground woody tissue respiration was about 0.75 t C ha^{-1}; and annual photosynthesis and respiration of the over-canopy were about -12.75 and 1.15 t C ha^{-1}, respectively (Fig. 4). Therefore, annual gross primary production (GPP), net primary production (NPP), net ecosystem production (NEP), and ecosystem respiration for this forest were estimated to be about 13.49, 7.16, 2.04, and 11.45 t C ha^{-1}, respectively. The contributions of canopy respiration, aboveground woody respiration, root respiration, and heterotrophic respiration to GPP were about 8.1%, 5.6%, 30.6%, and 40.5%, respectively.

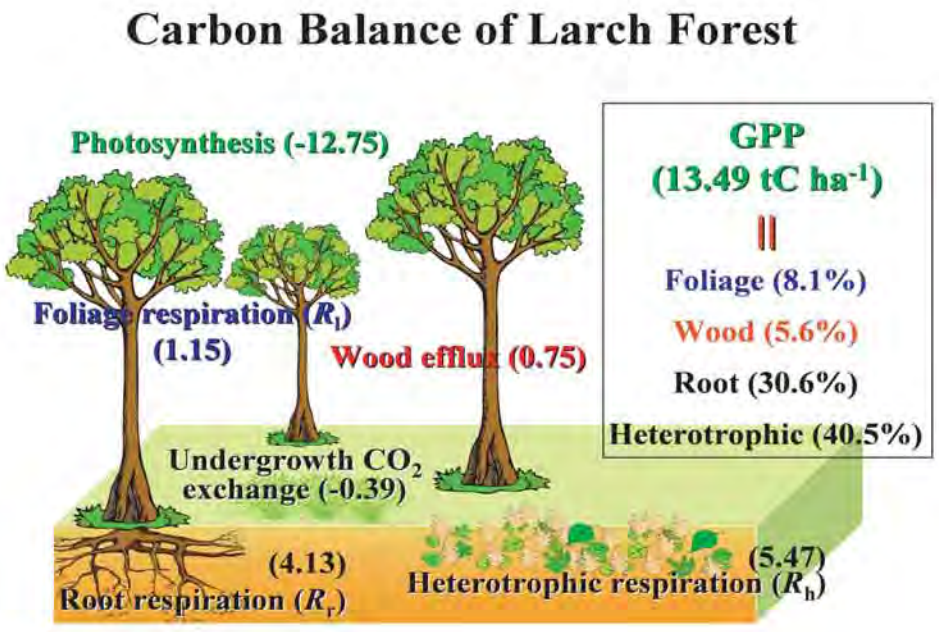


Fig. 4
Carbon balance in a 50-year-old larch forest at the Tomakomai Flux Research Site.

Ecosystem modeling approach

The objective of this study is to develop an ecological process-based model for estimating CO_2 absorption by a managed forest ecosystem in Japan. This kind of ecological modeling approach will be needed as a verification tool for reporting carbon sink activities under the Kyoto Protocol. In particular, ecological modeling is very important for establishing full carbon accounting, which is expected to be the next generation carbon accounting system. The input parameters of the model are environmental and forestry data on a 1-km grid scale. Testing with carbon flux data from Tomakomai revealed that the model reproduced the flux data very well, and we succeeded in dividing photosynthesis into levels, including that of the understory vegetation. The accuracy of the flux data obtained at the test sites was very high, but the number of test sites was limited and there was insufficient spatial data. Therefore, we are using forest inventory data to improve the ecological model. This year, as the first stage of use of the forest inventory data, we verified the accuracy of the tree-growth model used in TsuBiMo.

Remote sensing approach

To remotely estimate the NPP of a Japanese larch forest, we investigated the relationship between remotely sensed vegetation indices (NDVI, normalized difference vegetation index; PRI, photochemical reflectance index) and parameters of a simple light-use efficiency (LUE) model in the mature larch forest at the Tomakomai Flux Research Site over a growing season. In the simple LUE model, NPP can be expressed as the product of the photosynthetically active radiation (PAR), the fraction of absorbed PAR (fAPAR), and a light-use efficiency factor (ε). In our previous study in 2003, we confirmed that the PRI (= [R531nm-R570nm] /[R531nm + R570nm]), one of the remote vegetation indices obtained by hyper-spectral observation, was a useful index for estimating the ε of larch needles. In the current study, on a canopy scale we clarified the fact that the ε and fAPAR of mature larch forest were well correlated with canopy PRI and canopy NDVI ([Rred - Rnir]/[Rred + Rnir]), respectively. This suggests that observation of PRI and NDVI is a powerful tool for remote estimation of the NPP of Japanese larch forests.

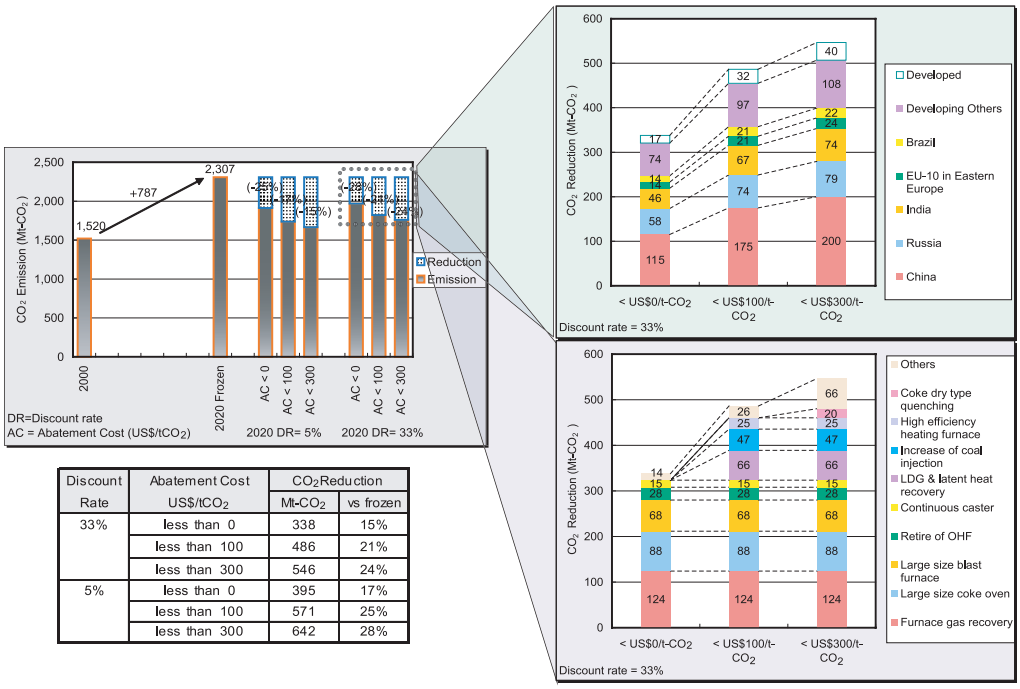
Sub-project on climate change scenarios and comprehensive mitigation strategies based on integrated assessment models

This sub-project resulted from the outcomes of research over the past 10 years at NIES and aims to address new policy needs arising from the Kyoto Protocol and post-Kyoto negotiations, and to assess long-term integration between climate and sustainable development policies. The target of this sub-project is to develop a set of models for integrated assessment of economic growth, climate change, and the impact of growth on the environment. These models will then be used to help estimate the effects of the Kyoto Protocol as well as long-term intervention scenarios on global climate change and its regional impacts. The sub-project is also expected to identify the most effective future strategies for integrating sustainable development in Asia and climate change mitigation under alternative paths of future development.

The three research teams involved in this sub-project -the Socioeconomic and Emission Modeling Team, the Climate Model Research Team, and the Impact and Adaptation Modeling Team- achieved the following outcomes in FY 2004.

The **Socioeconomic and Emission Modeling Team** used emission models to estimate emissions of greenhouse gases (GHGs) and air pollutants for scenario and policy analyses in major Asian countries such as Japan, China, India, Korea, Thailand, Indonesia, and Vietnam. Strategies to reduce GHG emissions in Japan through to 2050 have been studied with the Asia-Pacific Integrated Model (AIM)/Enduse model, which has been extended to enable us to estimate the global GHG reduction potential. This model has also been extended to calculate the marginal abatement costs and reduction potential of various abatement technology options in different emission sectors. The results of such studies are extremely useful for prioritizing investments and public policies to reduce GHG emissions. We have estimated the GHG emission reduction potential in the steel sector in 2020 by assuming future service demands and discount rates (Fig. 5). The Emission Modeling Team also refined the economic model to estimate the effects of investment on national recycling systems and

environmental policies in Japan and India. The team is in the initial stages of developing similar models for China, Korea, and Thailand. Our strategic database of innovative environmental options has also been updated and was used to estimate the effects of technology and management options on the reduction of GHG emissions.



Discount Rate	Abatement Cost US$/tCO2	CO2Reduction Mt-CO2	CO2Reduction vs frozen
33%	less than 0	338	15%
	less than 100	486	21%
	less than 300	546	24%
5%	less than 0	395	17%
	less than 100	571	25%
	less than 300	642	28%

Fig. 5
Potential reduction of CO_2 emissions from the steel sector in 2020, as simulated by the Asia-Pacific Integrated Model.

The **Climate Modeling Team** conducted a series of climate change simulations for the 20th and 21st centuries, in collaboration with the Center for Climate System Research (CCSR) at the University of Tokyo and the Frontier Research Center for Global Change (FRCGC) at the Japan Agency for Marine-Earth Science and Technology. Part of the simulations was performed with the world's highest-resolution coupled atmosphere-ocean climate model (approximately 100 km for the atmosphere and 20 km for the ocean) on one of the world's fastest super-computers, the Earth Simulator. The results suggest that summer precipitation over Japan in relation to the East Asian monsoon (in Japanese, 'Baiu') would be more intense and persistent in the future, owing to changes in pressure patterns. Extremely high precipitation would be more common owing to increased atmospheric moisture. In spite of the unpredictable weather, the number of tropical days (days with maximum temperature higher than 30˚C) would increase markedly (Fig. 6).

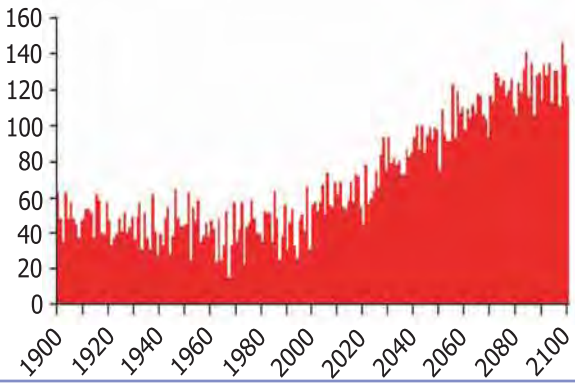


Fig. 6
Simulated number of tropical days over Japan in the 20th and 21st Centuries.

The **Impact and Adaptation Modeling Team** analyzed the costs and effects of introducing advanced facilities for water supply and waste water treatment in several Asian countries (Fig. 7). Better facilities such as household piped-water connection and sewer connection can decrease diarrheal mortality. However, the costs of introducing and running these facilities are relatively high. By using the quantitative results of these analyses, we can compare alternative future strategies for achieving development goals. The team also exhaustively collected research articles and government reports that evaluated such adaptation options and created a reference database. The database is proving useful for investigating effective adaptation options and for planning novel and functional research.

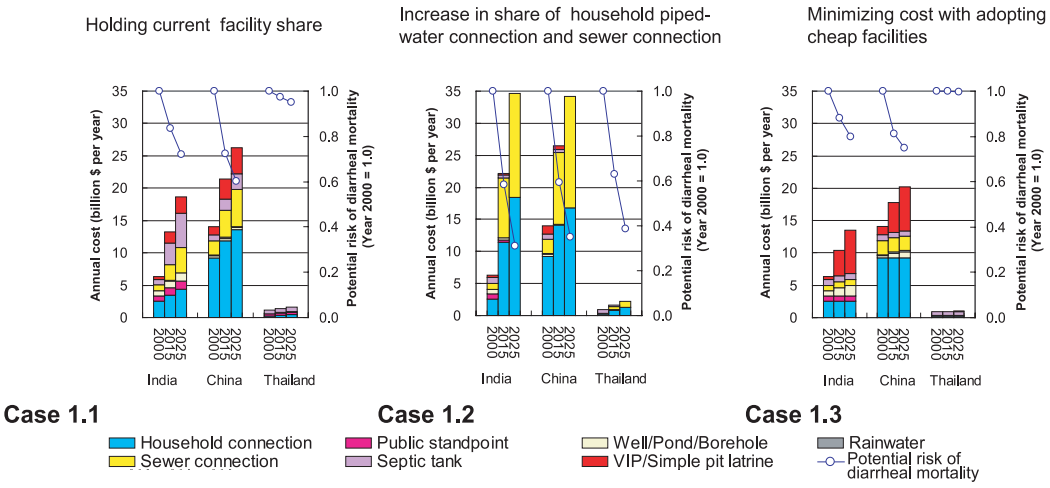
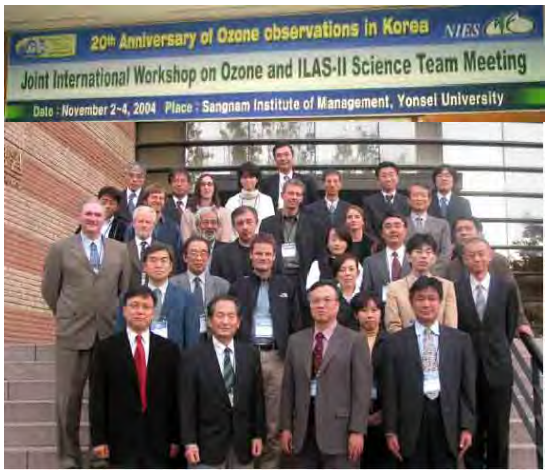
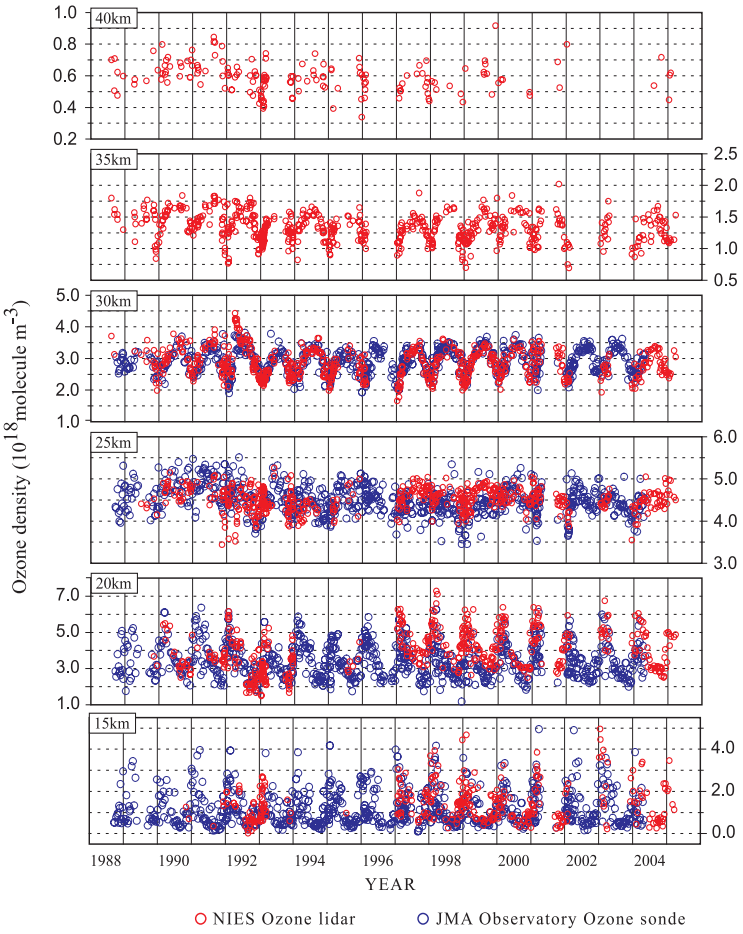


Fig. 7
Costs and effects of introducing advanced facilities for water supply and waste water treatment.

Ozone Layer Research Project



Participants in the ILAS-II Science Team Meeting, held at Yonsei University in Korea in November, 2004.



Ozone lidar monitoring data are registered in the database of the Network for Detection of Stratospheric Change

Background and Purpose

Owing to the regulation of ozone-depleting substances such as chlorofluorocarbons and bromofluorocarbons, the stratospheric abundance of organic chlorine and bromine compounds is believed to have started to decrease. It is expected that concentrations of stratospheric halogens (chlorine and bromine) will return to 1980s levels during the middle of this century. Nevertheless, the Antarctic ozone hole still appears to be growing larger, even considering its great annual variation, and springtime ozone depletion over the Arctic is increasing. Therefore, it may not be appropriate to predict the scale of ozone depletion by chlorine content alone. Continuous monitoring of the stratospheric ozone layer is required to explore how the ozone layer is changing in response to the decreasing concentration of halogens in the stratosphere. We also need to accumulate scientific knowledge on the meteorological conditions and climate of the stratosphere, as well as on the physical and chemical processes that affect the depletion of the ozone layer.

The state of the stratospheric ozone layer over both poles (high latitude regions) is strongly related to the occurrence of polar stratospheric cloud (PSC) particles and aerosols, as well as to the strength of the polar vortex. Polar ozone concentrations are influenced by these ozone-depleting factors through the direct and indirect effects of chlorine and bromine compounds and nitrogen oxides on ozone layer chemistry. To predict future changes in the polar ozone layer, we need to conduct detailed observations to gain an understanding of the detailed chemical and physical processes in the polar regions, including the mechanisms of PSC formation. Using satellite-borne sensors, we have monitored stratospheric ozone and species relevant to ozone layer destruction in the high-latitude regions. The stratospheric ozone layer over the mid-latitudes is also susceptible to changes in transport processes and to in situ chemical ozone loss. Accordingly, we have been monitoring, and will continue to monitor, the ozone layer in the mid-latitudes by using ground-based remote-sensing equipment. We have gathered data both from within and outside Japan to help monitor and identify mechanisms of change in the ozone layer. As part of this project we also conduct data analysis and numerical modeling to accumulate scientific knowledge on mechanisms of change in the ozone layer, thus contributing to the prediction and validation of future ozone layer changes.

Objectives

The 5 main objectives of this project are: 1) provision of validated Improved Limb Atmospheric Spectrometer (ILAS) data products to the scientific community; 2) data processing and validation of ILAS-II observations; 3) continued ground-based ozone layer monitoring at Tsukuba (NIES) and Rikubetsu (Rikubetsu Integrated Stratospheric Observation Center, Hokkaido) for registration of the obtained data in the Network for Detection of Stratospheric Change (NDSC) international database; 4) identification of the roles played in polar ozone layer changes by processes involving physically and chemically important elements, and identification of the mechanisms of these processes; and 5) validation of predicted future ozone layer

changes as a basis for formulating measures to protect the ozone layer, and validation of the latest predicted ozone layer changes to provide expert knowledge for evaluating the effectiveness of these protection measures.

Achievements in Fiscal Year 2004

The following work is highlighted.

1. Data Processing and Validation of ILAS-II Observation

ILAS-II was launched on board the Advanced Earth Observing Satellite (ADEOS)-II satellite on 14 December 2002. It was pre-operational between January and early April 2003, and then operational by the time ADEOS-II ceased operation on 24 October 2003 due to a failure of the satellite's power supply. During these periods, ILAS-II obtained 5890 observations, ranging in latitude from 54˚N to 71˚N and from 64˚S to 88˚S, depending on the season. Measurements were made 14 times about every 24 hours for each of the hemispheres at sunrise, as seen from the satellite in the Northern Hemisphere, and at sunset as seen from the satellite in the Southern Hemisphere. Vertical profiles of atmospheric constituents, such as ozone, nitric acid, nitrogen dioxide, methane, nitrous oxide, and water vapor, were processed from the spectral data by using the retrieval algorithm Version 1.4. Aerosol extinction coefficients were observed at a wavelength of 780 nm and at the wavelengths of 4 infrared window spectral elements. Temperature and pressure profiles were also observed.

(i) Ozone: The quality of ILAS-II version 1.4 ozone data was assessed through comparisons with results obtained from comprehensive ozonesonde measurements and 4 satellite-borne solar occultation sensors. In the Northern Hemisphere in the altitude range between 11 and 40 km, the ILAS-II ozone data agreed with the other data within ± 10% (in terms of the absolute difference divided by its mean value). Above 41 km, the ILAS-II values became smaller in comparison with the other data with increasing altitude, with a maximum deviation of –30% in the altitude range of 61 to 65 km. In the Southern Hemisphere, the ILAS-II ozone data agreed within ± 10% with most of the other data in the altitude range between 11 and 70 km (Fig. 1).

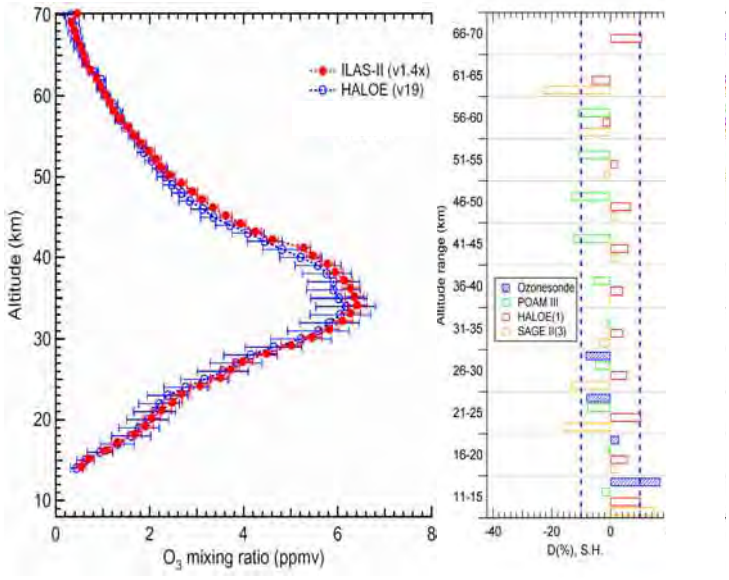


Fig.1
Profiles of ozone volume mixing ratios retrieved by ILAS-II and HALOE (Halogen Occultation Experiment) in the Southern Hemisphere (S.H.) (left panel). Average percentage difference values, D (%), between ILAS-II and reference measurements are shown (right panel). POAM = Polar Ozone and Aerosol Measurement III

(ii) Nitric Acid: Stratospheric vertical profiles of nitric acid (HNO_3) concentration observed by ILAS-II (version 1.4) were validated using coincident HNO_3 measurements by balloon-borne instruments (MIPAS-B2 and MkIV) in March and April 2003. Further validation was performed by making climatological comparisons of the lower stratospheric HNO_3–ozone (O_3) correlations obtained by ILAS-II and ILAS for specific potential vorticity-based equivalent latitudes and seasons where and when ILAS data showed very compact correlations in 1997. The reduced scatter of ILAS-II HNO_3 values around the reference HNO_3, which was derived from ILAS-II O_3 using the ILAS HNO_3–O_3 correlation, showed that the precision of the ILAS-II HNO_3 data was better than 13% to 14%, 5%, and 1% at 15, 20, and 25 km, respectively. Combining all of the comparisons made in this study, we estimated the accuracy of the ILAS-II HNO_3 profiles at 15 to 25 km to be better than –13% to +26%.

2. Monitoring of Vertical Ozone Profiles over Tsukuba with Ozone Lidar

Since 1988, ozone lidar measurements have been performed at Tsukuba (lat. 36˚N, long. 140˚E) to monitor the vertical profiles of stratospheric ozone, temperature, and aerosols. The lidar data were processed using the newly developed Version-2 algorithm that includes several new methods to correct for background signals, signal-induced noise, and dead-time effects. The vertical temperature profiles were calculated from the Rayleigh terms of the lidar data by using the daily combined NCEP + CIRA (National Centers for Environmental Prediction + Committee on Space Research International Reference Atmosphere) air density profiles and then compared with NCEP data. Aerosol backscattering coefficients were calculated from lidar signals using SAGE II extinction data. After correction for the effect of aerosol on lidar signals, the lidar ozone concentration profiles were retrieved. The lidar ozone profiles agreed with the SAGE II profiles within ± 10% in the altitude range between 17 and 40 km (Fig. 2) and were registered in the NDSC database.

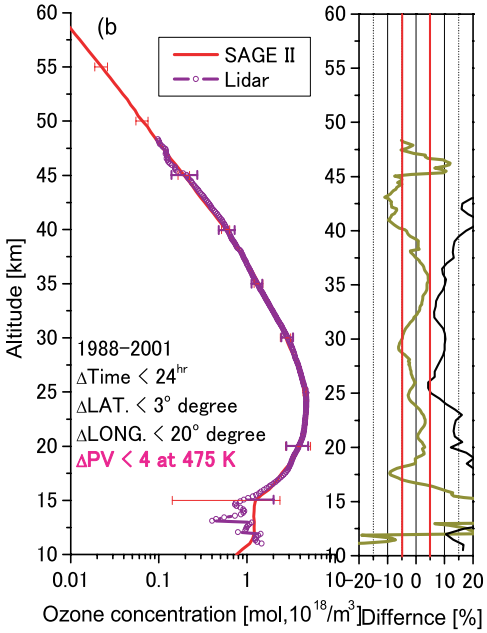


Fig.2
Average profiles of ozone volume mixing ratios retrieved by ozone lidar and SAGE II (Stratospheric Aerosol and Gas Experiment II) (left panel). Percentage difference values between Ozone lider and SAGE-II are shown (right panel).

3. Effects of atmospheric sphericity on stratospheric chemistry and dynamics over Antarctica

To accurately estimate photolysis rates in the polar stratosphere, we incorporated the effects of atmospheric sphericity into the plane-parallel radiative transfer (RT) scheme in the nudging Chemical Transport Model (CTM) and the Atmospheric General Circulation Model (AGCM) with coupled chemistry. This was done by modifying the plane-parallel RT scheme by the introduction of a pseudo-spherical approximation. A shift in the onset of the ozone decrease over Antarctica to earlier dates and a decrease in the minimum value of total ozone in the spherical atmosphere version (SA version) were seen in both the nudging CTM and the AGCM. The earlier decrease in ozone mixing ratio in the SA version than in the plane-parallel atmosphere version (PPA version) was caused by the earlier increase in ClO concentration in the SA version; this increase was initiated by the upward solar radiation flux at solar zenith angles greater than 90˚ (Fig. 3).

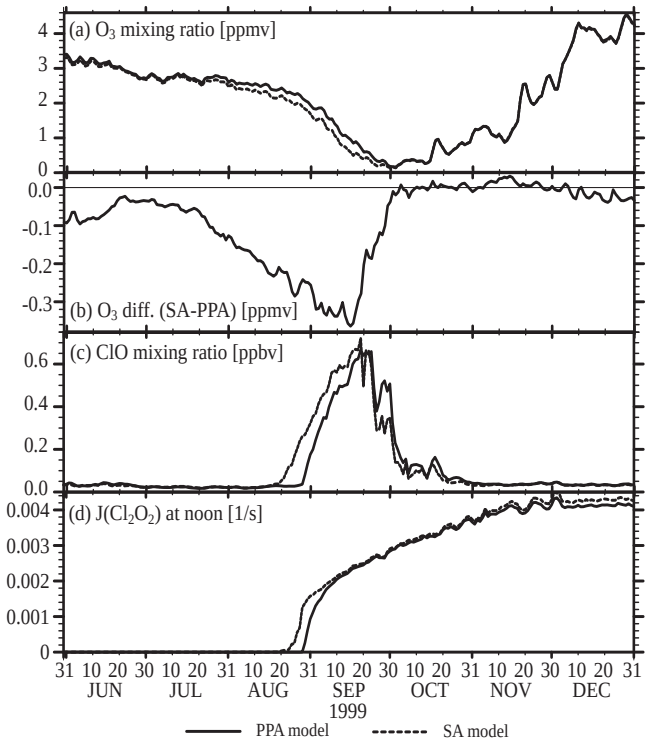


Fig.3
Time evolution of zonal-mean ozone mixing ratio at lat. 80˚S and 50 hPa (a); difference between the SA version and the PPA version (SA version values minus PPA version values) (b); zonal-mean ClO mixing ratio (c); and photolysis rates of Cl_2O_2 at local noon (d), simulated by nudging CTM from June to December, 1999. Solid and dashed lines in (a), (c), and (d) indicate the results calculated by the PPA version and the SA version, respectively.

During the ozone recovery period over Antarctica, the total ozone amount ozone in the SA version of the AGCM was still lower than in the PPA version, whereas the variation and absolute values for total ozone in the PPA version and the SA version of the nudging CTM were almost the same after the ozone minimum (Fig. 4). Because the AGCM results differ from those of the nudging CTM, the behavior of the Total

ozone during the ozone-recovery period cannot be explained by chemical processes alone. The lower ozone concentration over Antarctica in the SA version makes the latitudinal gradient of temperature larger and the polar vortex stronger than in the PPA version. The delay in the polar vortex break-up then causes a delay in ozone recovery in the SA version.

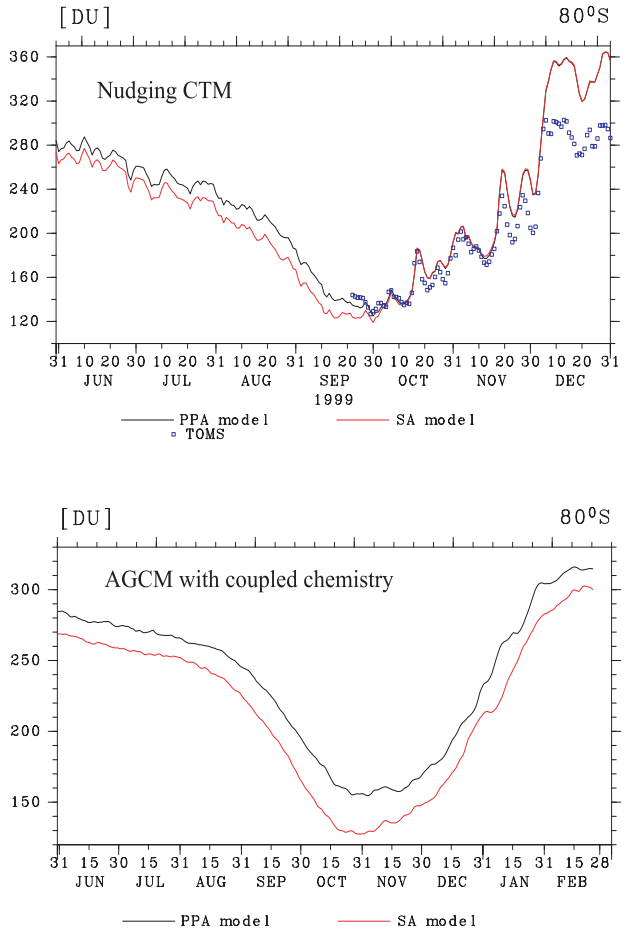


Fig.4
Time evolutions of zonal-mean total ozone over lat. 80°S, as simulated by nudging CTM (upper panel) and by AGCM with coupled chemistry (lower panel). Open circles in the upper panel denote TOMS (total ozone mapping spectrometer) observation data.

Endocrine Disrupters and Dioxin Research Project

「Photo;N. Takarazako」

Medaka (Oryzias latipes) as a test species for the evaluation of endocrine active substances.

The work of the Endocrine Disrupters and Dioxins Research Project has covered the following 4 themes: 1) development of methods for measurement and bioassay of these substances; 2) evaluation of the current status of environmental pollution; 3) hazards and effects assessment; and 4) development of countermeasures and integrated information technologies. In FY 2004, we made major advancements in the following areas.

1) We demonstrated the applicability of laser ionization time-of-flight mass spectrometry for real-time measurement of polychlorinated biphenyls (PCBs). Picosecond 266-nm laser light ionization reduced fragmentation and provided very high PCB detection sensitivity. This high sensitivity has advantages in terms of real-time monitoring capability compared with the conventional GC-ECD (gas chromatography – electron capture detection) or GC-MS (GC – mass spectrometry) methods, which require at least several days for the analysis of PCBs. Detection sensitivity of under 0.01 mg/Nm^3 was achieved with a 1-min measuring time; this sensitivity was superior to the exhaust gas control guideline of 0.15 mg/Nm^3 by a factor of 10.

2) Estrogenic and thyroid activities of 91 monohydroxylated PCBs were measured with 2-hybrid assays using yeast cells containing the human thyroid hormone receptor TRα. Of the 24 active compounds, 10 (42%) were *ortho*-phenols, 7 (29%) *meta*-phenols, and 7 (29%) *para*-phenols. Inspection of the results suggested that although the most active compounds, 2´,4,5´,6-TCB-2-ol and 3´,5,5´,6-TCB-2-ol, had their phenolic hydroxyl groups in the *ortho* position, the actual position of the phenolic hydroxyl group might be of rather less importance than the number of substituents (chlorine or phenyl ring) *ortho* to the phenolic hydroxyl. Thyroid hormone activity appeared not to depend strongly on the position of the phenolic hydroxyl, although *ortho*-hydroxyl occurred in the most active compounds, suggesting that the other (non-phenol) phenyl ring might serve as the required *ortho*-hydrophobic bulk (the role played by the iodine *ortho*- to the phenolic hydroxyl in triiodothyronine (T3)).

3) The estrogenicities of 10 compounds found as impurities in industrial grade bisphenol A (BPA) were measured by yeast 2-hybrid assays incorporating the human estrogen receptor (hER) or the medaka fish (*Oryzias latipes*) estrogen receptor (mER). Five impurities showed greater activity than BPA itself in an agonist assay for hER. *p*-Cumylphenol, the most active of the impurities in the hER assay, was 12 times as active as BPA. Five impurities showed greater activity than BPA in an agonist assay for mER: 4,4´-(1,3-dimethylbutylidene) bisphenol and 2-(4´-hydroxyphenyl)-2,4,4-trimethylchroman were nearly equipotent and 9 times as active as BPA. Comparison of the experimentally determined estrogenicities of mixtures of BPA and 4,4´-(1,3-dimethylbutylidene) bisphenol and those calculated by the concentrations addition (CA) method confirmed the suitability of the method for predicting the estrogenicities of mixtures of BPA and its phenolic analogues. The measured estrogenicities of 4 samples of industrial grade BPA and laboratory grade (pure) BPA were not significantly different in either the hER assay or the mER assay ($P > 0.05$ in each

case). We concluded that although some of the impurities in industrial grade BPA have much higher estrogenic activity than BPA itself, the total amount of impurities does not significantly increase the estrogenicity of the industrial compound.

4) We studied the effects of endocrine-disrupting chemicals (EDCs) on the central nervous system. To investigate the effects on the human brain, we exploited noninvasive imaging methods using high field magnetic resonance imaging (MRI). Three-dimensional anatomical images covering the whole brain at 1-mm resolution were collected from 50 healthy volunteers. We are now trying to analyze those images volumetrically. We have also developed methods for obtaining functional brain images by equipping the system with visual stimulation apparatus and by optimizing the ultra-fast imaging technique on MRI and synchronizing the stimulation (Fig. 1).

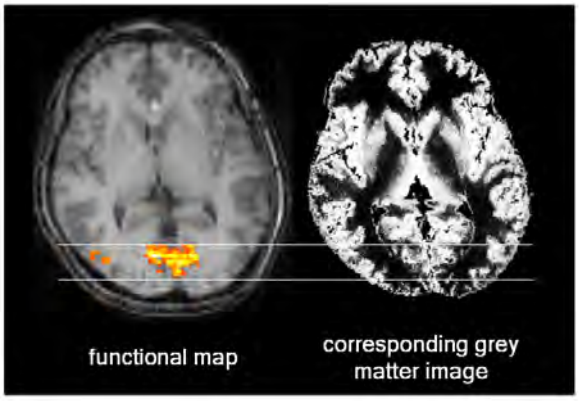


Fig. 1
Human brain functional map activated by visual stimulation (left), and a gray matter image in the corresponding plane segmented from a 3-dimensional T1-weighted image (right). Functional map shows voxels activated by stimulation of both eyes with a checkerboard pattern flickering at 16 Hz. Activated voxels are well correlated with the gray matter in the occipital lobe.

Model animals challenged with bisphenol A (BPA), trimethyltin (TMT), or propylthiouracil (PTU) were examined using behavioral, immunopathological, and neurobiochemical techniques. BPA administered intracisternally to neonatal rats caused hyperactivity concomitant with the presence of TUNEL-positive cells in the mesencephalon, where immunoreactivity to tyrosine hydroxylase was reduced by the chemical. We also examined the effects of PTU-induced perinatal hypothyroidism on various behaviors in adult mice. Perinatal hypothyroidism caused high ambulatory activity in adult mice, and this activity was accompanied by higher responses to dopamine agonists. The results suggest that perinatal hypothyroidism causes changes in dopamine system functions. The roles of interleukin (IL)-1α and IL-1β expressed in reactive gliosis were examined in hippocampal damage induced by TMT. Both IL-1α and IL-1β immunoreactivities were double-labeled with the astrocyte marker vimentin but not with the microglial marker OX-42. Expression of IL-1α and -1β was enhanced by adrenalectomy before TMT administration.

5) We investigated the etiology of hydronephrosis in response to TCDD exposure. Dams of C57BL/6 mice were given a single oral dose of 10 μg TCDD/kg-bw 1 day after normal delivery, and pups were euthanized at specified times for pathophysiological and biomolecular analyses. Histopathological examination of the hydronephrotic kidneys of pups on postnatal days (PNDs) 7, 14, and 21 showed no apparent obstruction due to hyperplasia, and immunostaining for cytochrome P450

(CYP) 1A1 was confined to the distal tubular epithelium (Fig. 2). Pups that developed hydronephrosis manifested polyuria with elevated levels of Na and K in the urine and decreased concentrations of Na and K in the blood circulation. Microarray analysis with subsequent analysis by real-time RT-PCR of kidney tissues from pups showed altered expression of Na and K channel transporter genes at least as early as PND7. These results not only demonstrate a new finding of hydronephrosis without morphological obstruction, but also suggest a novel molecular mechanism to explain the etiology of this malformation, a mechanism that may be driven in an xenobiotic response element (XRE)-dependent fashion.

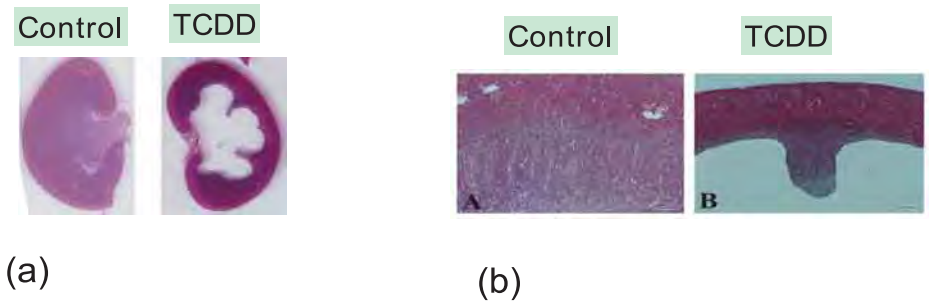


Fig. 2
(a) Hydronephrosis was observed in the kidneys of mouse pups exposed to TCDD via their mothers' milk. Histopathological examination of the hydronephrotic kidneys revealed no apparent obstruction due to hyperplasia.
(b) Immunostaining for cytochrome P450 (CYP) 1A1 was confined to the distal tubular epithelium.

6) To determine the effects of EDCs on wildlife, we observed sea snails and bivalves along the Japanese coast. In a series of studies to clarify the roles of retinoid X receptor (RXR) on the development of imposex caused by organotin compounds in gastropods, we performed *in vivo* injection experiments, using a natural ligand of retinoic X receptors (RXRs), 9-*cis* retinoic acid (RA). After a month of injections, female rock shells (*Thais clavigera*) developed imposex, with substantial penis growth. Penis length and vas deferens sequence index (VDSI) were significantly increased compared with those of the controls ($P < 0.01$ and $P < 0.001$, respectively). A repeat series of *in vivo* injection experiments using 9-*cis* RA resulted in the development of imposex in a dose-dependent manner in female rock shells after a month of single injection. The penis and vas deferens that were 'imposed' or developed in female rock shells that received injections of 9-*cis* RA were histologically the same as those in male rock shells. We analyzed RXR gene expression in various tissues (ctenidium, testis or ovary, digestive gland, penis or penis-forming area, and ganglia) of wild male, female, and imposex-exhibiting female rock shells using real time RT-PCR. Of all the tissues analyzed in both males and imposex-exhibiting females, the highest value of RXR gene expression was observed in the penis; of all of the tissues analyzed in normal females, only a slightly (non-significant) higher value was observed, in the penis-forming area. RXR gene expression in the penises of males and imposex-exhibiting females was 9.3 and 6.2 times higher, respectively than in the penis-forming area of normal females ($P < 0.05$ and $P < 0.01$, respectively). These results support our hypothesis that RXR plays an important role in differentiation and growth of the penis (and possibly also the vas deferens) in both males and females exposed to organotin compounds such as tributyltin (TBT).

7) We investigated the factors causing population decline in marbled sole, *Pleuronectes yokohamae*, in Tokyo Bay. Marbled sole is one of the most important target species in commercial fisheries in Tokyo Bay, and the total catch has been

markedly decreasing since the late 1980s. High fishing pressure had been strongly suspected as one of the major factors responsible for this decline, but results from our earlier study suggested that fishing pressure was not the major cause. In addition to fishing pressure, recent attention has turned to the potentially negative effects of endocrine-disrupting chemicals on marbled sole. We have been investigating the adverse effects of these chemicals on the reproduction of P. *yokohamae* in Tokyo Bay by establishing the waters off Shiriuchi in Hokkaido as a reference site and using multiple methods, including the estimation of life history parameters and histopathology. To date, no disturbance of reproductive cycles between the sexes and no abnormalities in the gonads (e.g. testis-ova) have been observed in either Tokyo Bay or Hokkaido. However, abnormally high levels of serum vitellogenin have been detected in males from Tokyo Bay (Fig. 3). These data suggest that some feminization of adult males might be occurring in Tokyo Bay. In addition, we have started to examine the adverse effects of environmental chemicals on the early life stages of P. *yokohamae*, and have detected relatively high concentrations of chemicals such as nonylphenol in the bottom sediments of the major spawning/nursery grounds for marbled sole in Tokyo Bay. These chemicals may be having adverse effects on marbled sole in the early life stages (eggs–juveniles).

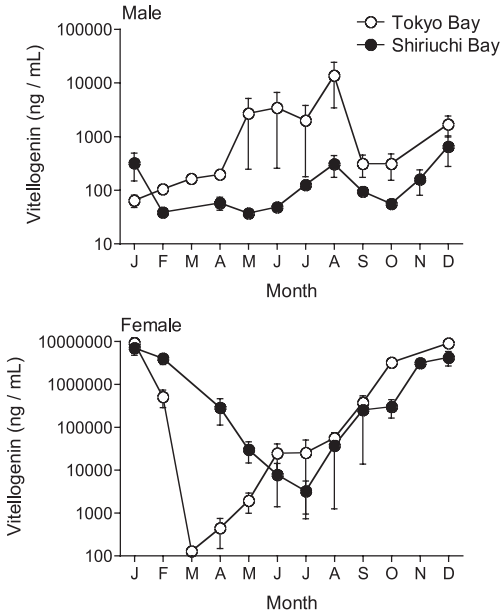


Fig. 3
Seasonal variation in serum vitellogenin levels in marbled sole, Pleuronectes *yokohamae*, from Tokyo Bay and from the waters off Shiriuchi, in Hokkaido, in 2003.

8) To reduce emissions of dioxins and prevent secondary emissions to the environment, we have been studying a method of monitoring and decomposing dioxins. We have developed a simple sampling method that uses a special adsorbent filter for flue gases from municipal waste incinerators, and in FY 2004 we continued to examine the application of the filter to real-time monitoring. We also studied the biological decomposition of EDCs—especially bis(2-ethylhexyl) phthalate (DEHP)—in polyvinyl chloride by a soil bacterium isolated from the gardens at NIES . The bacterial strain was identified from a database as *Mycobacterium* sp. by its 16S rDNA sequencing homology. The primary degradation products of DEHP were 2-ethylhexanol and phthalic acid, suggesting that the biological reaction occurring might be hydrolysis. A fungal strain identified as Cordyceps sinensis was isolated from the

soil; this fungus was able to utilize many kinds of cyclic ethers such as 1,4-dioxane as its sole source of carbon. In FY 2004 we studied the decomposition pathways of several dioxin congeners and found that decomposition of dioxins by this strain was accompanied by cleavage at the oxygen atoms of the ether bonding between the two benzene rings in the dioxin structure, but no simple dechlorination reaction was observed. We also surveyed new chemical dechlorination methods for chlorobenzenes. Several combinations of solvents and aluminum and palladium catalysts were tested, and the results showed high degradation rates on a laboratory scale.

9) We have continued to develop an integrated risk assessment and management framework for endocrine-disrupting chemicals and other environmental contaminants by the comprehensive integration of information and methodologies into an assessment scheme. These efforts have resulted in the development of a “Virtual World” geographic information system (GIS).
Our FY 2004 study continued on from our efforts in FY 2003, including the development of an environmental fate modeling methodology, system, and databases; development of emission inventory modeling methodologies; and statistical and geographic analyses of monitoring data. We developed the grid-catchment integrated modeling system (G-CIEMS)—a multimedia fate model for geo-referenced and spatially resolved fate simulation on a GIS system—for the entire Japanese land environment and the surrounding ocean. Model validation was carried out in an international model comparison study performed in collaboration with the Meteorological Synthesizing Centre – East under the Long-Range Transboundary Air Pollution convention of the United Nations Economic Commission for Europe. The G-CIEMS model showed generally good agreement with other multimedia fate model outputs for selected PCB congeners. We thus confirmed the consistent ability of the model to simulate the multimedia fates of persistent organic pollutant (POP) chemicals, in line with other multimedia fate models in the world. We used the model to study the long-range transport characteristics of selected chemicals around Japan, and we confirmed the importance of the rain assumption, especially for chemicals with low volatility (Fig. 4). We also used the G-CIEMS to model the exposure distribution of nonylphenol and its ethoxylates in the river water environment. Preparation of a database of EDCs continued in FY 2004, with the incorporation of recent information.

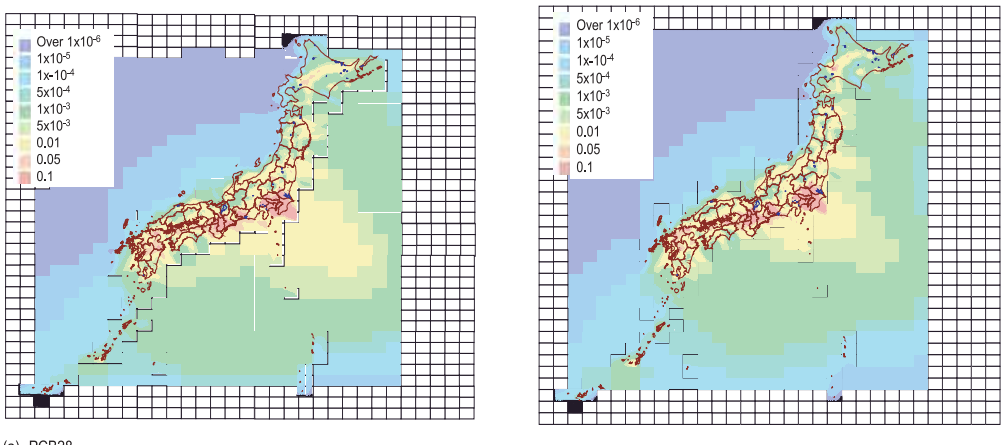


Fig. 4
Transport simulation of PCB (polychlorinated biphenyl) 28 and TeBDE (tetrabromodiphenylethers) by the grid-catchment integrated modeling system (G-CIEMS).
(a) PCB28, (b) TeBDE

Biodiversity Conservation Research Project

「Photo;M.Fukushima」

Some of the freshwater fish species native to northern part of Japan.

The recent rapid expansion of human activity worldwide has resulted in continuing degradation of wildlife habitats and loss of biological diversity. In addition, ecological disruption by the incursion of invasive species and the production and release of genetically modified organisms has become a new problem. In the Biodiversity Conservation Research Project, which is composed of the 5 research teams described below, we are developing methodologies to assess changes in biodiversity on a variety of spatial scales, and are researching the ecological disruption caused by invasive species and genetically modified organisms.

Wildlife Population Research Team

As the need to prevent the extinction of wild species is increasing, the Wildlife Population Research Team has been researching the mechanisms of population colonization and extinction, which comprise the process of species persistence. In this fiscal year, we have not only applied, but also tried to develop, microsatellite DNA markers to monitor the viability of wild populations. Furthermore, we have predicted the suitability of habitats for those species across landscapes. In one example, we used a GIS to draw a map of habitat suitability for medaka, a freshwater fish, in the 1960s and 1970s. We used a multivariate analysis to characterize records of the distribution of medaka on a land cover map of a mainly agricultural landscape (Fig. 1). Cross-validation of habitat suitability by resampling of the distribution records confirmed the reliability of the habitat suitability map. The distribution of medaka was positively related first with that of rice fields and second with that of urban areas.

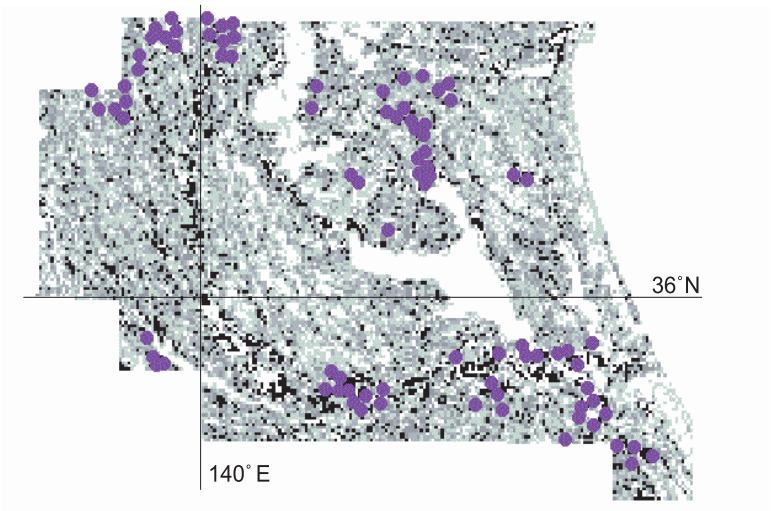


Fig. 1
Map of habitat suitability for medaka, a freshwater fish, drawn from records of the presence of the fish and from a land cover map for southern Ibaraki Prefecture in the 1960s and 1970s. Darker grid cells indicate higher suitability. Blue points indicate locations of recorded presence.

Biological Invasion Research Team

Today, invasive alien species (IAS) are among the main factors threatening biodiversity worldwide. The Japanese Government enacted a new law, the Invasive Alien Species Act, in 2004 to control the ecological impacts of IAS. By this law, the introduction, rearing and release of all the alien species specified as invasive are restricted. It is therefore urgent that we establish clear criteria and guidelines for assessing the ecological risks of IAS.

On the other hand, even in the new law, little attention has been paid to invasion by alien parasites, which can cause very serious ecological damage. Only diseases that are a threat to humans and domestic animals have been restricted in Japan, although

many of the animals imported as pets and many of the plants imported as biological materials are likely to carry unknown microorganisms. Therefore, we need urgently to assess the status of parasite invasion and its ecological risks. In our present study we aim to develop methods of IAS risk assessment, and we will emphasize investigations into the problem of parasite invasion.

We are concentrating on the investigation of 2 species: European bumblebees imported for pollination of tomato crops and exotic stag beetles imported as pets. The recent naturalization of the introduced bumblebee, *Bombus terrestris*, in Japan is expected to have a strong impact on the native bumblebee community. We are investigating the present status of the naturalization of *B. terrestris* and the ecological features of this species. We found *B. terrestris* in 9 of 30 monitoring sites, and it was the dominant species in 2 of those sites. An overwintering queen of this species was found under the soil in a deciduous forest. Both open environments for nesting habitat and forests for hibernacula are needed for naturalization of this species.

To determine which preserves were the most important for stag beetles (*Dorcus titanus*), we accumulated information on the collection sites of the native beetles and estimated their geographical distribution in combination with temperature data on a map. Simultaneously, we obtained information on the sites of pet shops selling the exotic beetles. On the basis of the growth of the exotic beetles at zero temperature, we also estimated which geographical areas were likely to be the sites of naturalization of the exotic species. Furthermore, we constructed an evolutionarily significant unit (ESU) map for the native species on the basis of their mitochondrial DNA phylogeny. By comprehensive analysis of these data maps, we determined which areas contained precious and endemic ESU populations, pet shops, and habitats suitable for the exotic species. We found that each of the South-west Islands met these criteria. We settled on this area as the most important preserve of stag beetles.

As there has been little investigation of the parasites of stag beetles, it is very difficult to estimate the potential ecological risks caused by the invasion of such parasites. However, we have found and listed many species of mites attached to commercial exotic individuals. We have also investigated the genetic variation of an endoparasitic mite, *Coleopterophagus berlese*, which is one of the most common mites living on the surface of the stag beetle. We collected the mite from individuals of native and exotic *D. titanus* and analyzed the sequence variation of extracted mtDNA. As with the mtDNA of *D. titanus*, we are constructing a phylogenetic tree of mtDNA haplotypes of the mite. The tree indicates genetic divergence among mite strains. Furthermore, the associations between host stag beetle and parasitic mite phylogenies show that the mites have diverged into strains specific to the host strains. Such host specificities indicate that the associations between the host and the parasite transcend speciation events and are therefore relatively old. These investigations suggest that the importation and commercialization of stag beetles will disturb not only the evolutionary process of stag beetles but also the co-evolutionary associations between stag beetles and their parasites; this is likely to have an unexpected influence on native stag beetle populations.

Fig. 2
Hybrid obtained from a cross between the Japanese and Indonesian Hirata stag beetles .

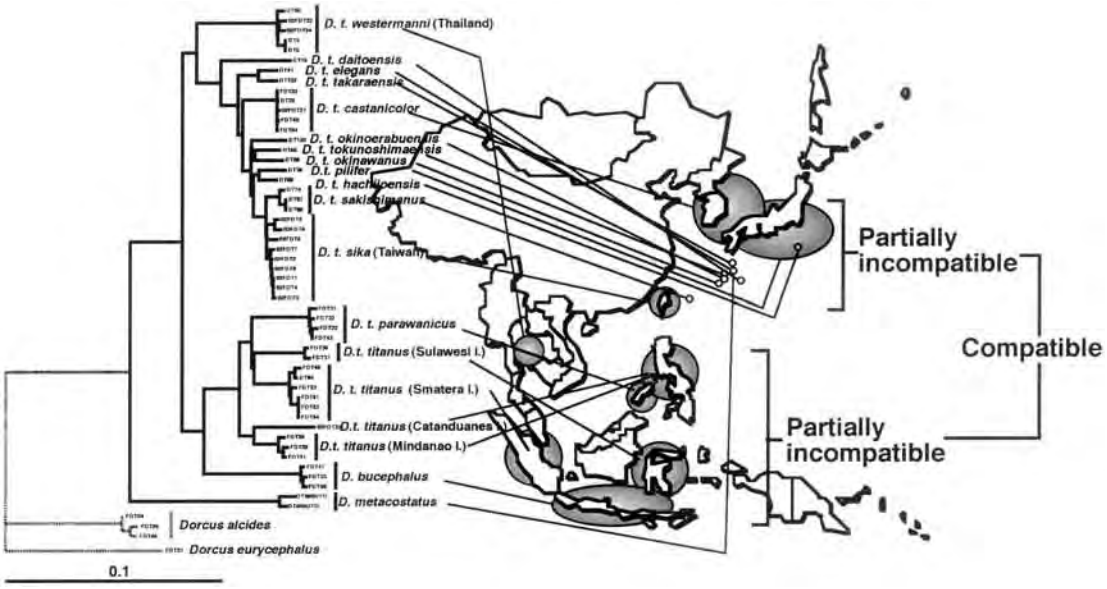


Fig. 3
Phylogeography of Asian Hirata stag beetle strains and the genetic compatibility between them.

Ecological Landscape Research Team

Existing conservation areas that are implicitly thought to protect biodiversity have frequently been established with little or no regard to ecological criteria for their selection. Gaps between the actual distributions of organisms and such human-configured reserves may be identified and corrected through the predictive modeling of potential habitats. Using a fish database derived from more than 6700 surveys, we developed habitat models for the 37 dominant freshwater fish species in Hokkaido and have used a GIS to predict the geographical patterns of the probabilities of occurrence of the species throughout Hokkaido, which, according to 1:50,000 topological maps, is composed of a total of 574 catchments. We then evaluated the effectiveness of 32 catchments designated since 1960s as conservation areas for the enhancement of fishery resources such as Pacific salmon populations. If the 32 catchments were selected randomly, their average rankings for the 37 dominant fish species would theoretically be between 230th and 345th among the 574 catchments,

as a 95% confidence interval (Fig. 4). It turned out that 4 of the 37 species, including two salmonids and ayu, a highly-valued species, had higher probabilities of occurrence, whereas the majority of species (27), including threatened species such as the Sakhalin taimen (*Hucho perryi*), Pacific brook lamprey (*Lethenteron reissneri*), and eight-barbel loach (*Lefua nikkonis*), had lower probabilities of occurrence in the conservation areas than could be expected from random selection. Therefore, although the existing conservation areas are quite successful in protecting the habitats of some commercially important fish species, relying solely on these areas for conservation of the entire spectrum of freshwater fish species is unrealistic, and additional reserves are definitely needed.

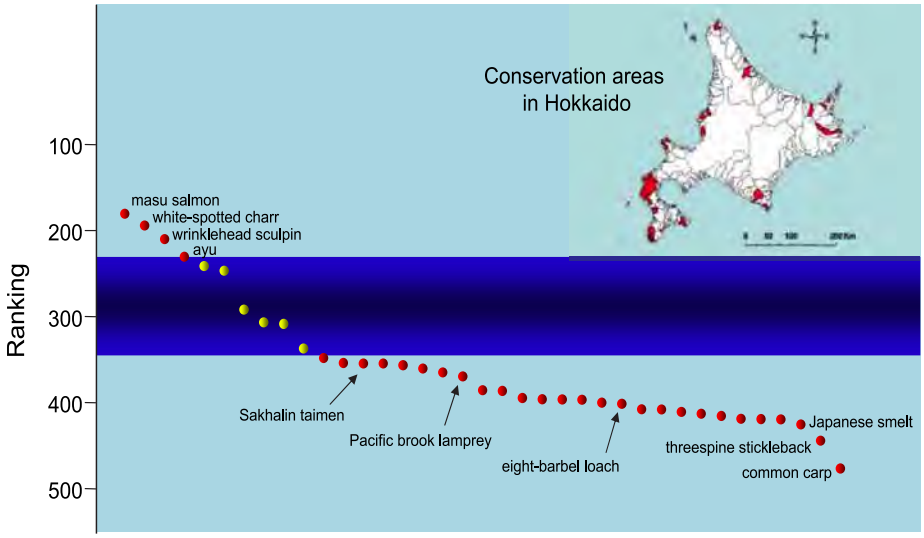


Fig. 4
We ranked the 574 catchments that comprised Hokkaido according to the predicted probabilities of fish occurrence, and we plotted the average rankings of 32 existing conservation areas (see inset) for the 37 dominant fish species. The 95% confidence interval of the rankings, as expected from random selection, is indicated (blue shading).

Community Dynamics Research Team

Numerous hypotheses for the mechanisms of coexistence of tree species within a forest have been proposed. One of them is the temporal fluctuation of reproduction, that is, the concept that species coexistence of sessile organisms competing for space is promoted if each organism produces offspring more than once in its lifetime, and this reproduction is synchronous within each species but asynchronous among species. A minority species may recover its population size when it produces offspring and the other species do not. In 2003, we studied how tree species with different competitive abilities coexist under fluctuating reproduction. We found that less competitive species can coexist with more competitive ones when reproduction varies temporally. In 2004, we studied how local processes related to species coexistence affect the global dynamics of forest vegetation in response to climate changes. We performed a simulation study with multiple tree species for which reproduction had different temperature dependencies. We found that temporal fluctuation of reproduction, which enhances local species coexistence, results in a broader distribution range of individual species. Furthermore, the fluctuation facilitated a shift in the distribution range following climate change. These results indicate the close linkage between local and global processes in forest ecosystems.

We conducted a simulation study of the dynamics of species diversity within a virtual food web system, taking into account the evolution of species. In 2004, we focused on the impact of disturbances to the system that cause sudden reductions in population size of some of the virtual species within the system. We found that even small-scale disturbances can lead to extinction of species not directly affected by the disturbance. This suggests that high-frequency disturbances can have indirect negative effects on species diversity within an ecosystem. We also found that less diversified clades (groups of species originating from common ancestors) are susceptible to low-frequency disturbances.

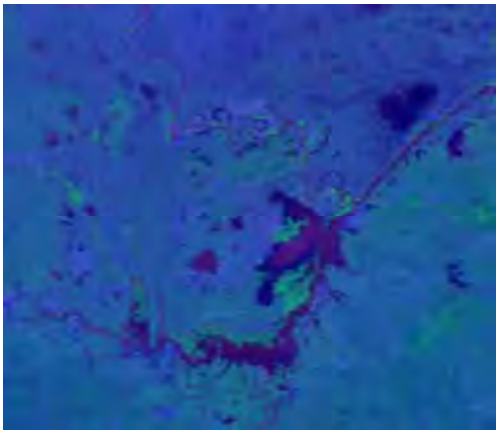
Biotechnology Risk Assessment Team

Genetically modified (GM) or "transgenic" organisms have been generated million tonnes, of which about one-fifth is oilseed rape (*Brassica napus* L.) seed. It has been estimated that about half of these imports have two herbicide resistance genes (for glyphosate and glufosinate resistance). During their transport to factories as material for food and feed production, escape of seeds is possible. However, the propagation of escaped GM oilseed rape has not yet been elucidated. We surveyed escaped GM oilseed rape growing in the Kanto area. Among 139 samples, 5 collected from Kashima Port and 8 from along Route 51 were glyphosate resistant. One sample from Kashima Port, 2 from along Route 51, and 1 from along Route 124 were glufosinate resistant. No herbicide-resistant plants were found in samples from riverside areas, along Route 50, along Route 125, or in the Bousoh area. Our results suggest that propagation of GM oilseed rape was limited to roadsides.

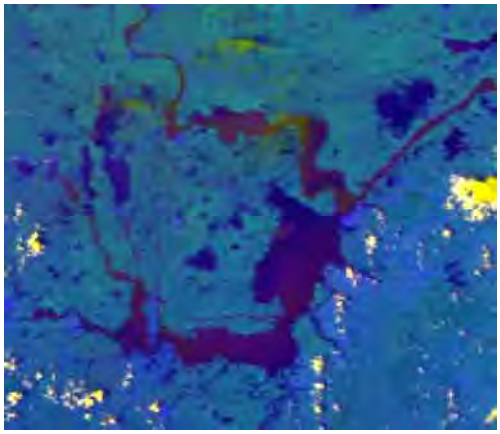
In another study, to monitor the fate and activity of genetically engineered microorganisms introduced into the environment, we developed a method for quantifying mRNA of methane monooxygenase (MMO) genes in a trichloroethylene-degrading bacterium, *Methylocystis* sp. M, by reverse transcription-polymerase chain reaction (RT-PCR). To optimize conditions, we developed a procedure for isolating RNA from bacterial cells and a treatment method for removing genomic DNA. The quantities of mRNA were determined by using an ABI Prism 7700 Sequence Detection System with one-step RT-PCR and a fluorogenic probe and primers specified for each MMO gene. This method was able to distinguish between the mRNA of soluble and particulate MMOs and rapidly determine the quantities of each mRNA.

Fig. 5
Herbicide treatment test of oilseed rape seedlings. Collected oilseed rapes were propagated in a greenhouse for 2 weeks and then treated with herbicide. Left: before treatment. Right: after treatment. Nucleotide sequences of herbicide-resistant genes were identified in the surviving plants.

Watershed Environments and Management Research Project



May 26 1998, before flood



August 23 1998, during flood

Image of the area surrounding Dongting Lake, as observed by National Oceanic & Atmospheric Administration (NOAA) 14 - Advanced Very High Resolution Radiometer (AVHRR)

Three Gorges Project Dam site

Introduction

As part of an examination of the rapid environmental changes in the Asia-Pacific Region, our Watershed Environments and Management Research Project focuses on water circulation in East Asia, working to scientifically observe and understand the ecosystem functions of river basins. In addition to developing methods to forecast the degradation and recovery of ecosystem functions through models that manage a river basin environment on the basis of ecosystem function, we try to propose sustainable environment management plans that cover the application of environmental recovery technologies, reevaluation of development plans, and reduction of environmental load. As one part of our research project, we have applied an integrated catchment hydrologic model to estimation of the flood protection effect of China's Three Gorges Project (TGP).

The plain and lake area in the middle and lower regions of the Changjiang River basin is well known to have the most concentrated, frequent, and severe floods . During the 40 years after the 1954 flood , prevention of medium- and small-scale flooding was much improved in the middle and lower reaches, but the threat of major flooding remained. The TGP is the largest water-conservation project ever undertaken in China, and indeed the world, with a normal pool level of 175 m and a total reservoir storage capacity of 39.3 billion cubic meters. The TGP is expected to control flooding not only in the area along the main stream of the Changjiang River but also in the area surrounding Dongting Lake, which connects directly with the Changjiang River. We have no doubt that the TGP will exert a flood protection effect in the mainstream section receiving the direct contribution of discharge control from the dam site. However, it is difficult to understand the mitigation effect on Dongting Lake only from the viewpoint of the TGP flood control capacity without considering the water balance in the lake and outflow as a result of hydraulic interaction with the Changjiang River.

Using the case of the severe 1998 flood, the second-largest of the last century, we first used the integrated hydrologic model to simulate the 1998 runoff process at daily time intervals for the middle region of the Changjiang basin. Then, using the discharge rate calculated by assuming flood-control operation in the TGP reservoir as the input data for the upstream side of the Changjiang main stream in the model, we examined what the flood-control effect of the TGP would have been in the area around Dongting Lake during the 1998 flood event.

Study area

The study area corresponds to the mainstream section from Yichang to Luoshan in the middle of the Changjiang basin, including 445 km of the Changjiang main stream and a catchment of 294 911 km^2 (Fig. 1). One main tributary (the Qingjiang) and one large lake (Dongting Lake) flow into the main stream in this area. The Qingjiang is located to the south of the middle reaches of the Changjiang, and the Dongting Lake is located to the south of the main stream in the middle region. Dongting Lake has a total surface area of 2691 km^2, a volume of 174×10^8 m^3, and a catchment area of 263 000 km^2. The main rivers feeding Dongting Lake are the Xiangjiang, Zishui, Yuanjiang, and Lishui.

Application of the integrated catchment hydrologic model

To simulate the daily runoff process in the study area, we used an integrated catchment hydrologic model consisting of a Hydrological Simulation Program – FORTRAN (HSPF) – developed by the United States Environmental Protection Agency, and two sub-models, the Paddy Runoff Model (PRM) and the Lake Discharge Model (LDM), both developed by NIES. PRM was used for daily water balance simulation in paddy fields, including for the artificial water supply process. LDM was used to simulate the daily water balance in Dongting Lake, as affected by the hydraulic interaction between Changjiang main stream and the lake. As meteorological input data for simulating the hydrology of the middle region of the Changjiang, we used spatially distributed precipitation and potential evaporation data. By using a representative spatial interpolation method, universal kriging, we generated daily precipitation data for 1998 with a regular spacing of 0.25˚ (lat./long.) from the daily rain gauge precipitation data collected at 194 stations distributed over the study area. We used the streamflow data measured in the Changjiang basin in 1998 to provide the boundary conditions and to calibrate and validate the model (Fig. 1; hydrologic stations #1 to #9).

Hydrologic stations
1. Yichang
2. Luoshan
3. Changyang
4. Xiangtan
5. Taoyuan
6. Chenglingji
7. Lujiao
8. Yingtian
9. Wanzihu
10. Cuntan (Chongqing)
11. Wulong

Fig. 1
Location of the study area in the Changjiang River basin, Three Gorges Dam section, and the hydrologic stations used in this study for input of the model data and validation of the model's performance.

In terms of the flood control operation of the TGP, only if the reservoir inflow surpasses the safety discharge in the downstream reaches will the reservoir be used to retain floodwater. However, the reservoir water level will still be lowered to 145 m after the flood peak has passed through. On the basis of these provisos, by applying the water balance equation to the Three Gorges section with a fixed upper limit value to cut the reservoir inflow peak, we input the data for the TGP daily discharge conditions during the flood period of 1998 to the model. We set 4 fixed upper limit values: 40 000, 45 000, 50 000, and 55 000 m^3/s.

Model validation

Figure 2 (a) illustrates the simulated and observed daily average streamflows from April to October 1998 at Taoyuan hydrologic station (#5) on the Yuangjiang. As shown in this figure, the results confirm that the model could adequately simulate the daily runoff characteristics of all main tributaries in the catchment. Figure 2 (b) shows the simulated daily average lake water level and the observed daily water level at Lujiao (#7) on Dongting Lake. In the period from April to October, in addition to the graphical agreement between the simulated and observed values, there was a small difference between the total simulated (290×10^9 m^3) and observed (314×10^9 m^3) volumes of runoff from the lake to the Changjiang main stream. Figure 2 (c) illustrates the daily average streamflow simulated by the integrated catchment model and the observed daily streamflow from April to October 1998 at Luoshan hydrologic station (#2) on the Changjiang main stream, in the lower reaches of the junction with Dongting Lake. As shown by the graphical agreement between the simulated and observed values and the small error of the total runoff volume (1.04%) from April to October, the integrated model accurately simulated the fluctuation of daily streamflow in the main stream. The above results for the daily runoff simulation in the whole study area during flood period of 1998 confirm the applicability of our model as a tool for evaluating the flood protection effect of the TGP in the middle region of the Changjiang basin.

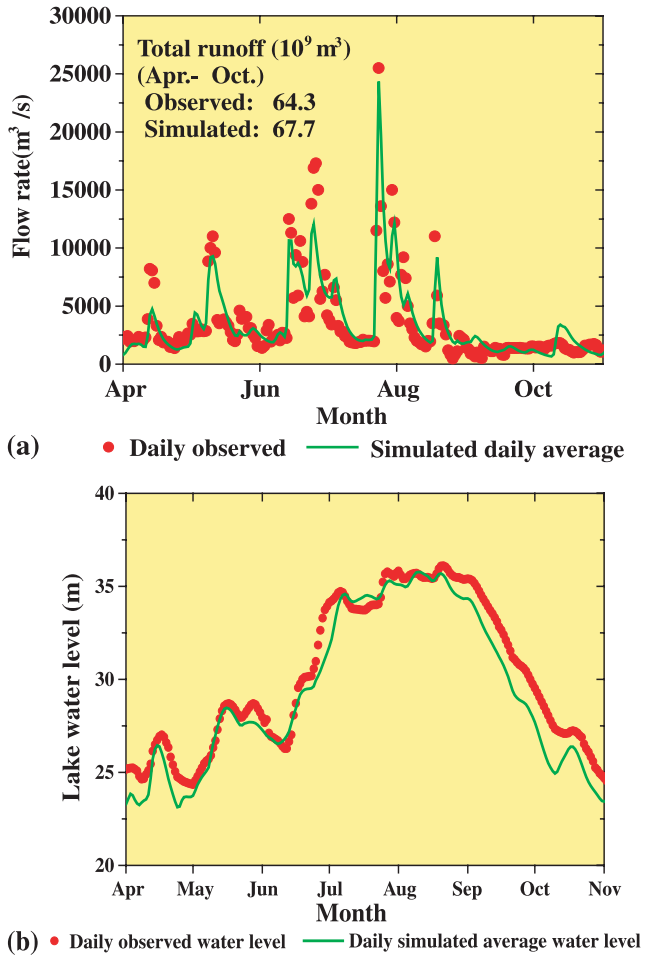
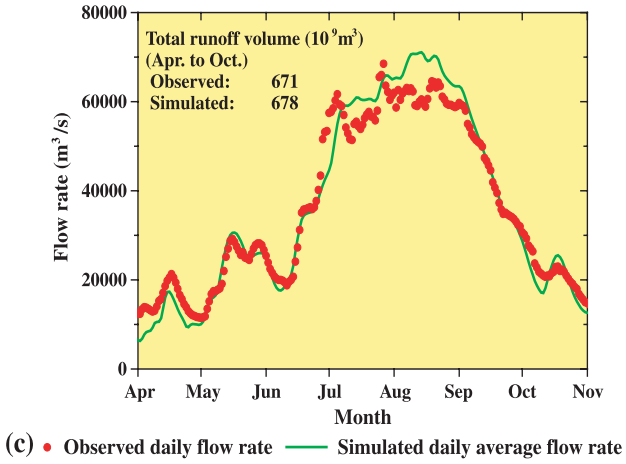


Fig. 2
Comparison of daily average results simulated by the integrated hydrologic model with the observed daily data.
(a) Simulated and observed daily average flow rates from April to October, 1998, at Taoyuan hydrologic station (#5 in Fig. 1) on the Yuangjiang River.
(b) Simulated daily average lake water level and observed daily water level from April to October, 1998, at Lujiao on Dongting Lake (#7 in Fig. 1).
(c) Simulated and observed daily average flow rates from April to October, 1998, at Luoshan hydrologic station (#2 in Fig. 1) on the Changjiang main stream well below the junction with Dongting Lake.



Application of the model to a study of the TGP flood protection effect

Figure 3 (a) shows the controlled discharge rates for upper limit values of 40 000, 45 000, 50 000, and 55 000 m^3/s, along with the daily observed streamflow rates, at Yichang on the main stream from June to October. To show the protective effect of the TGP against flooding in the Dongting Lake area during the flood period using each of the above controlled discharge rates as the upper boundary condition, Figure 3b presents the simulated fluctuation of the daily average water level in the lake with each of the controlled discharge rates as the input condition for the upper reach of the lake. When the water level (34.55 m) designed for flood protection at Chenglingji, located at the juncture with the Changjiang main stream, was used as the criterion to evaluate the flood protection effect when 50 000 m^3/s and more was used as the upper limit to control the discharge rate, the number of days on which this water level was exceeded in the simulation was higher than the number of days (34) obtained from the simulation results in which the observed daily streamflow rates at Yichang were used as the input data. Even when 45 000 m^3/s was used as the upper limit value, the number of days on which the water level was exceeded was 20, and the maximum simulated water level exceeded the above design water level by about 1.0 m at the beginning of August. On the other hand, when 40 000 m^3/s was used as the upper limit value, although the water level was exceeded on 8 days, the excess was only 0.15 m over 34.55 m at maximum.

In the event of a 1998-type flood, the above results suggest that, to obtain a marked flood protection effect of the TGP in the area around Dongting Lake, the daily average rate of discharge from the TGP during the flood period should be maintained at around 40 000 m^3/s. However, as shown by the daily fluctuation of the TGP reservoir storage water level simulated by the water balance equation using each of the upper limit values of the discharge rates and the inflow rates in the TGP section, together with the relationship between storage volume and water level, the simulated storage water level markedly exceeded the designed normal pool level (175 m). The maximum volume to be stored for flood control reached 484.9×10^8 m^3 at the end of August in the simulation of a reservoir operation being carried out to cut the peak inflow volume for an upper limit value of 40 000 m^3/s (Fig. 3 (c)). This maximum volume stored for flood control exceeded not only the designed flood control volume of the TGP (221.5

× 10^8 m^3) but also the total reservoir storage capacity (393 × 10^8 m^3). This result shows that if the discharge rate is maintained at around 40 000 m^3/s throughout the flood period, the reservoir operation of the TGP will probably fail if there is a reoccurrence of a 1998-type flood. Consequently, the TGP might not work effectively for flood protection in the area surrounding Dongting Lake.

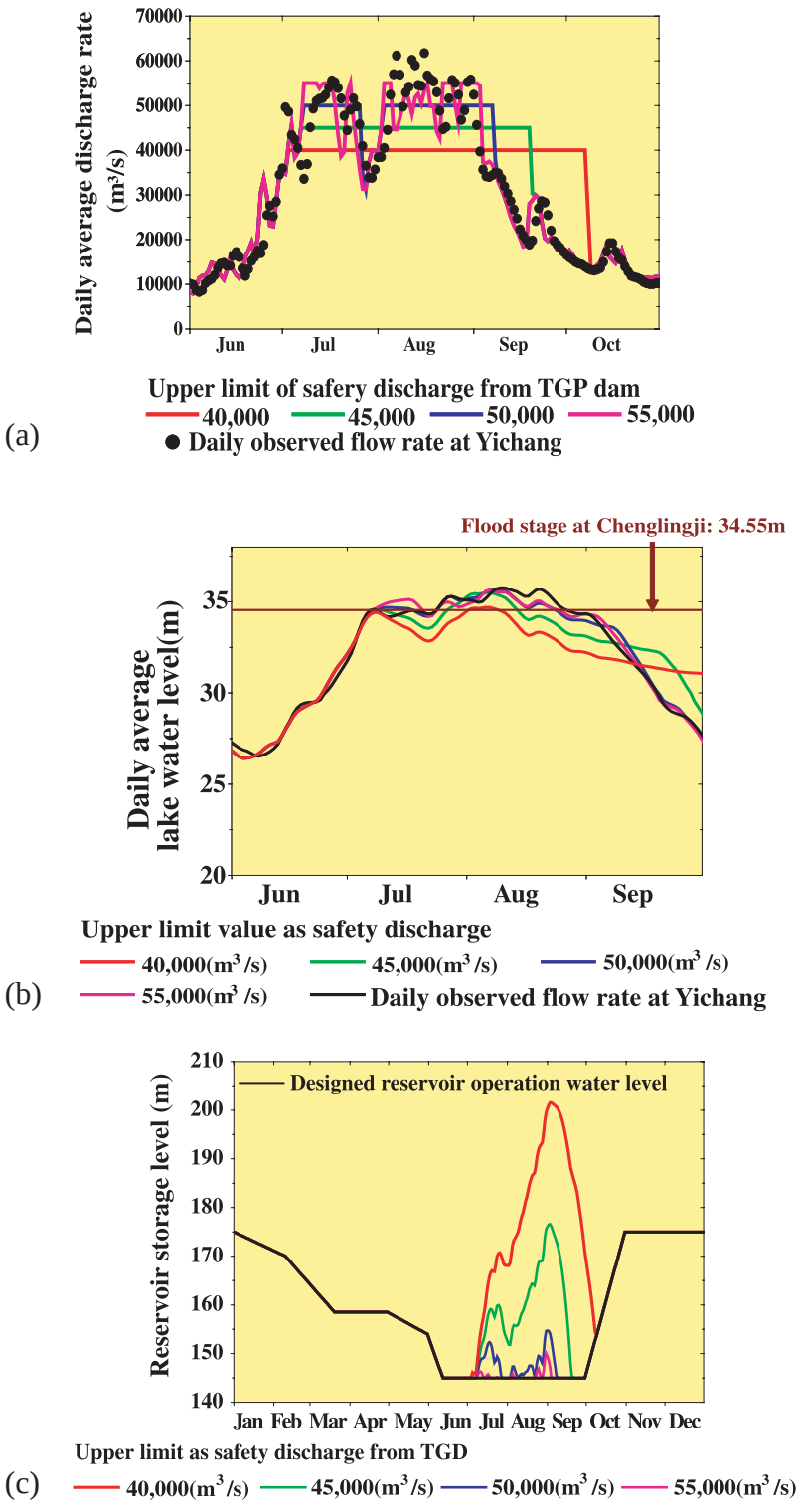


Fig. 3
Simulated effects of TGP reservoir operation on the reduction of flood occurrence in the area around Dongting Lake in the event of a 1998-type flood.
(a) Estimated controlled discharge rates using each of the upper limit values set at 40 000, 45 000, 50 000, and 55 000 (m^3/s) in the event of a 1998-type flood, and daily observed stream flow rates at Yichang hydrologic station on the main stream from June to October, 1998.
(b) Fluctuation of daily average water level of Dongting Lake from June to September, 1998, as simulated by using the discharge rates calculated using each of the 4 upper-limit values, and the observed daily flow rates at Yichang.
(c) Simulated daily fluctuation of the reservoir storage water level of the TGP, as determined by using the water balance equation with each of 4 upper-limit values for the discharge rates in the event of a 1998-type flood.

PM2.5 & DEP Research Project

Exterior of Nanoparticle health effect laboratory

Diesel engine and dynamo for generating nanoparticles

Dilution tunnel

Exposure chambers

Environmental fate and risk assessment of fine particulates and diesel exhaust particles

Air pollution from vehicle emissions remains a serious problem in urban areas. The PM2.5 & DEP Research Project Group is carrying out investigations to better understand the characteristics of pollution sources as well as the environmental fates of fine particulate matter ($PM_{2.5}$) and diesel exhaust particles (DEP) and the effects of these substances on human health.

Traffic Pollution Control Research Team

The Traffic Pollution Control Research Team formulated emission inventories and reduction strategies for PM, DEP, and other environmental burdens imposed by automobiles. We measured automotive exhausts on a chassis dynamometer, performed field surveys near trunk roads, compiled emission inventories, reviewed technical and regulatory measures, and developed GIS-based tools for assessing traffic pollution. In FY 2004, we examined the emission characteristics of a number of ultrafine particles from diesel vehicles on the chassis dynamometer under various driving conditions, using a full-flow dilution tunnel as well as an exhaust gas dispersion chamber. We measured the size distribution and chemical properties of ultrafine particles on the chassis dynamometer and at roadside sites under various traffic conditions.

We made progress in constructing a GIS-based integrated system for assessing the effectiveness of various policy measures: it consists of numerical sub-models of traffic flow, particulate emission and dispersion, and exposure assessment. We carried out a preliminary simulation of DEP concentrations in the greater Tokyo area, to compare the geographic distribution of the population's exposure to DEP before and after the implementation of the road pricing policy.

Urban Air Quality Research Team

The Urban Air Quality Research Team has been investigating the relationships between changes in the relative importance of various air pollution sources and the spatial and temporal distributions of urban air pollution. To clarify the behavior of airborne particulate matter—such as $PM_{2.5}$ and DEP—and gaseous air pollutants, we have been conducting wind tunnel experiments, field observations, data analyses, and computer model simulations. Using 3-dimensional field observations, data analysis of air pollution and meteorology, and a computer model simulation, we have been investigating the influence of trans-boundary air pollution (ozone, anthropogenic aerosols, and Asian dust) on urban air quality in Japan. We also continued our research into the mechanisms behind the observed increasing trend in ground-level ozone concentrations in urban and rural areas of Japan.

In FY 2002, a 3-year inter-institutional project started with the aim of reducing the air pollution caused mainly by diesel vehicles along heavily trafficked urban roads. Reduction strategies were: (1) enhancement of diffusion of exhaust emissions around roads by changing the roadside environment and (2) improvement of fuel to reduce the toxicity of diesel exhaust. In relation to strategy (1), we have conducted a series of thermally stratified wind tunnel experiments, focusing mainly on air pollution distribution around the heavily trafficked Ikegami-Shinmachi intersection in the city of Kawasaki, in order to study the current problems and to seek strategies to reduce

pollutant concentrations. In FY 2004, using a 1:300 scale model, we predicted the annual mean concentration distribution around the intersection (Fig. 1) and studied pollution reduction strategies. This year's work is an extension of the FY 2002 experiments, which used a 2-dimensional simplified 1:300 model of the area, and the FY 2003 experiments, which used a 1:100 scaled model of the area to elucidate the relationship between the flow and diffusion of pollutants in the vicinity of the road.

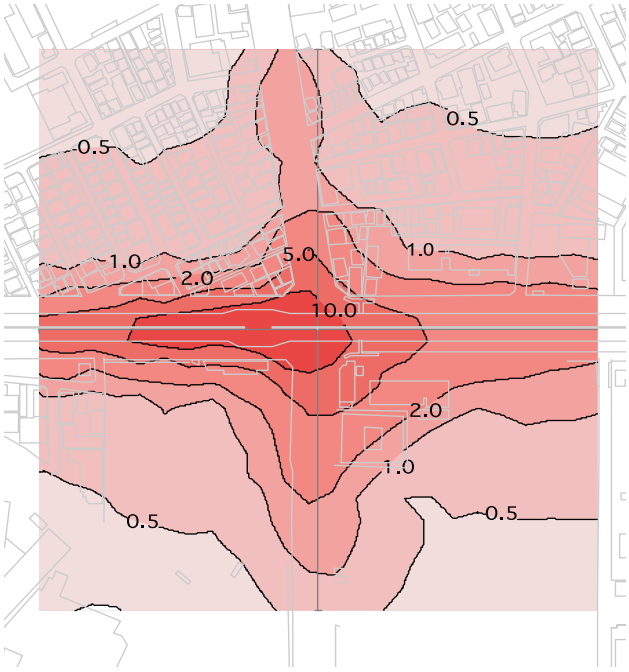


Fig. 1
Predicted annual mean concentration distribution (normalized) of pollutants around the busy Ikegami-Shinmachi intersection in Kawasaki.

Aerosol Measurement Research Team

To examine the applicability of the β-ray absorption method to the measurement of $PM_{2.5}$, we continued our comparative studies of other commonly used methods, such as the tapered element oscillating microbalance method (TEOM) and the gravimetric filtration method.

In addition, we performed parallel measurement testing of 4 black carbon (BC) monitors at a rural site and a roadside site. Each monitor used a different monitoring technique: reflectance, transmittance, multi-angle detection, or thermal detection. Time variation of BC concentration was reasonably detected by all the monitors. However, the concentrations differed from each other by a maximum factor of 6. The results obtained by using these monitoring techniques were appropriately correlated with those obtained by using the thermal optical reflectance (TOR) method to analyze concentrations in filter samples collected simultaneously; however, the trends in the relationships were different.

To measure the mass size distribution and analyze the size-separated chemical composition appropriately, we carried out parallel measurement testing of different types of cascade impactors using different sampling materials for DEP and particles in roadside atmospheres. When aluminum foil and a polycarbonate filter were used

as sampling materials, blow-off seemed to occur with non-rotating impaction plates. When a quartz fiber filter was used, the modal diameter shifted towards larger than those sampled when aluminum foil and a polycarbonate filter were used, probably because of differences in the thickness and roughness of these filters. However, these differences in measured mass size distributions also depended on the concentration of particulates in the sample air and the sampling duration.

Epidemiology and Exposure Assessment Research Team

The Epidemiology and Exposure Assessment Research Team is investigating the extent of human exposure to $PM_{2.5}$ and DEP. Assessment of exposure is an integral, essential component of environmental epidemiology, risk assessment, and risk management. The methodologies used to assess exposure employ various direct and indirect techniques, such as personal monitoring and modeling. We are currently investigating an exposure modeling approach for airborne PM, based on microenvironmental concentrations and time–activity data. So far, in cooperation with the Traffic Pollution Control Research Team and the Urban Air Quality Research Team, we have conducted a basic study using a GIS to establish an exposure assessment system. We have completed the first-phase model, which can calculate the level of exposure in the population according to the pollution concentration (calculated from a diffusion model using concentrations of air pollution emitted from roads and other sources) superimposed on the population distribution. We have also completed the second-phase model. The components of the second-phase model can include concentrations of PM in typical microenvironments (e.g. homes, roadsides, vehicles). In FY 2004, the final-phase model is almost complete. It consists of numerical models of traffic flow, particulate emission and dispersion, and exposure assessment. We examined the integration of a dynamic traffic flow simulation model into the system to assess the effectiveness of traffic demand management policies in terms of exposure (Fig. 2). In addition, we evaluated the model validation by sensitivity analysis.

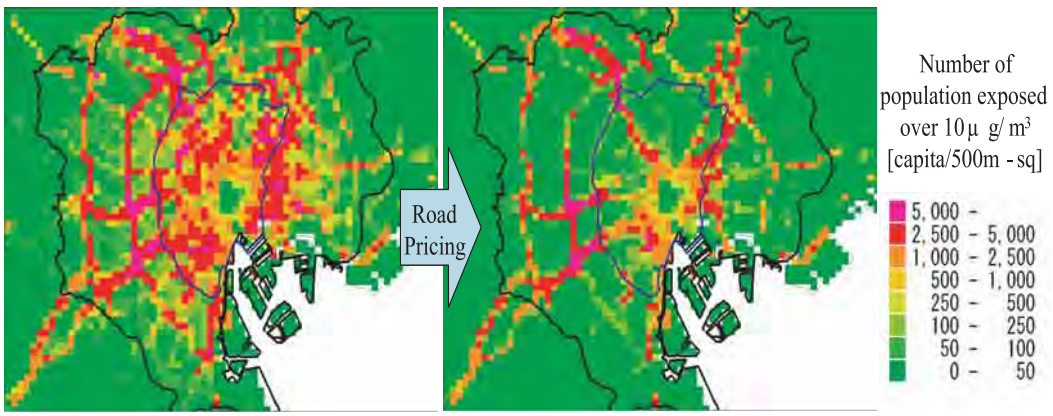


Fig. 2
Effect of exposure assessment on road pricing in the central Tokyo area.

We analyzed the data on vital statistics in various regions, looking for statistical correlations between PM exposure level and mortality rate. We conducted a data analysis of mortality rates in 13 large Japanese cities to investigate the short-term effects of particulate matter on mortality. These results suggest a positive relationship between PM concentrations and daily mortality in Japan, in agreement with many reports in the USA and Europe. We are now engaged in a prospective cohort chronic exposure study and in short-term morbidity studies conducted by the Ministry of the Environment.

Inhalation Toxicology Research Team

The Toxicity and Impact Assessment Research Team has designed toxicological studies to clarify the effects of DEP—major components of particulate pollutants—and $PM_{2.5}$ on cardiac, respiratory and immunological functions in animals.
Construction of a system of exposure to diesel nanoparticles has finished. We have now started to search for the optimum driving mode for the generation of nanoparticles.

Cardiac function

The effect of diesel exhaust (DE) on the cardiovascular system has not been fully elucidated. We have previously reported that DE exposure decreases heart rate (HR) dose-dependently and increases the frequency of arrhythmias in rats. Our results suggest that inhalation of particles included in DE enhances the provocation of arrhythmias and changes in cardiovascular function. We isolated and identified some of the compounds in DEP responsible for vasodilatation of the rat thoracic artery. Those were 3-methyl-4-nitrophenol (PNMC), 2-methyl-4-nitrophenol (PNOC), 3-phenylphenol-4-nitrophenol (PNPP), and 4-nitrophenol (PNP), all from a benzene extract of DEP. We also showed that PNMC significantly decreased HR and blood pressure in mice and rats. The mechanism of vasodilatation by the nitrophenols is associated with the action of endothelial NO synthase (eNOS) in the arteries. The results suggested that the mechanisms of vasodilatation and blood pressure reduction in response to DE exposure are the same as those that occur in response to the nitrophenols.

We trialed a system of exposure of rats to nanoparticles (mean diameter 25 or 100 nm) by nose only. Exposure to 25-nm nanoparticles decreased the HR and changed heart function indices such as the SDNN (standard deviation of normal-to-normal), suggesting that the particles had cardiac effects through the autonomic nervous system.

Respiratory and immunological function

We examined the effects of DE exposure on asthma-like symptoms and antigen-presenting (AP) activity in rats. Rats were exposed for 12 h/day for 1 month to DE-containing particles at 3.0 mg/m^3 or to filtered air (control). Rats were also made to inhale aerosolized ovalbumin (OVA) or saline for 10 min every week. DE exposure induced asthma-like symptoms, and OVA inhalation further increased the incidence of allergic asthma-like signs. The AP activity of bronchoalveolar cells tended to increase with DE exposure. The number and proliferative activity of mediastinal

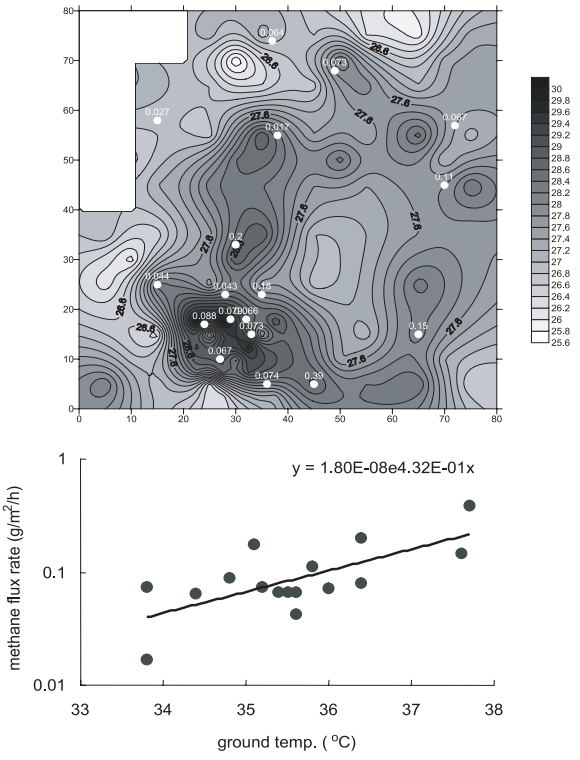
lymph node cells increased in the group exposed to DE with OVA. These results suggest that DE exposure aggravates allergic asthma-like symptoms and that the aggravation is caused by DE-induced hyperresponsiveness. Furthermore, the activation of local lymph node cells might also be one of the factors.

Pulmonary exposure to diesel exhaust particles (DEP) aggravates lung inflammation from bacterial endotoxin (lipopolysaccharide: LPS) in mice. Severe lung inflammation can reportedly induce a systemic inflammatory response and endothelial cell activation or damage. This study examined the effects of components of DEP on endothelial cell activation or damage, the systemic inflammatory response, and lung-to-systemic translocation of LPS in a murine model of lung inflammation. ICR mice were divided into 6 experimental groups that intratracheally received vehicle, LPS (2.5 mg/kg), organic chemicals in DEP (DEP-OC) extracted with dicloromethane (4 mg/kg), residual carbonaceous nuclei of DEP (washed DEP: 4 mg/kg), DEP-OC (4 mg/kg) + LPS (2.5 mg/kg), or washed DEP (4 mg/kg) + LPS (2.5 mg/kg). Levels of circulating E-selectin, activated protein C (APC), von Willebrand factor, fibrinogen, interleukin (IL)-1β, IL-6, keratinocyte chemoattractant (KC), and LPS were evaluated 24 h after pulmonary exposure. Both DEP components significantly exaggerated the increase in E-selectin and fibrinogen levels elicited by LPS. Washed DEP + LPS significantly decreased APC and elevated circulating levels of IL-6, KC, and LPS as compared with LPS alone, whereas DEP-OC + LPS elevated IL-6, KC, and LPS without significance. These results suggest that DEP components, especially washed DEP, can aggravate the systemic inflammatory response, endothelial cell activation or damage, and thrombohemostatic disturbance related to LPS in the respiratory system. These effects at least partly play an important role in the adverse effects of particulate air pollution on sensitive populations predisposed to vascular or pulmonary diseases, including ischemic vascular diseases and respiratory infections.

In vitro assay for toxicity of DEP

To elucidate the effects of DEP on the cardiovascular and respiratory systems, we examined the effects of organic extracts of DEP on the production of type I collagen by rat pulmonary fibroblasts, proliferation of rat aorta smooth muscle cells, activation of eNOS in rat heart microvessel endothelial cells, and migration of rat alveolar epithelial cells in vitro. Exposure to organic extracts of DEP increased type I collagen production, enhanced proliferation of smooth muscle cells, and suppressed eNOS activation in endothelial cells. Wound closure by alveolar epithelial cells was inhibited by exposure to organic extracts of DEP. These results suggest that hypertrophy, thickening, and contraction of vessels and bronchioles, as well as delaying of wound healing of the alveolar epithelium after injury, are likely sequelae of DEP exposure.

Research Center for Material Cycles and Waste Management



Landfill site

It seems possible to estimate methane flux from the ground surface temperature of landfills.

Introduction

To change the current economic and social trend of mass production, mass consumption, and mass disposal, actions are needed to realize a sound material-cycle society. The comprehensive roadmap for such actions is, however, still not clear. We do know what a society should *not* be, and indeed have developed and adopted various individual, environmentally sound technologies to reduce environmental loads. But we still do not know fully what a society *should* be—the "vision"—what new technologies are needed to mitigate environmental issues—the "measures"—and how such a sound material-cycle society can be realized—the "path". Under these uncertain circumstances the Research Center for Material Cycles and Waste Management was established at NIES in April 2001, and it has launched various research programs in an effort to clarify the social inquiries mentioned above.

We focus particularly on 3 areas of research: 1) material cycle systems, 2) material cycle technologies, and 3) material cycles and risk management.

(1) Material Cycle Systems Research

As a basis for supporting the transformation to a sound material-cycle society, it is essential that we synthesize various statistical data related to flows of materials such as resources, products, and wastes, and develop tools to analyze these data. We have made progress in compiling time-series data on waste generation, treatment, recycling and disposal by industrial sector and by waste type. Data for other environmental burdens have also been collected and compiled so that they can be linked with Japanese economic input–output tables for 2000. We have also performed case studies to capture the flows of specific materials and products such as waste plastics and end-of-life electronic products.

One of the focuses of our studies is the application of life-cycle assessment (LCA) to technologies for mechanical and chemical recycling of "other plastics" (i.e. plastics other than PET bottles) under the Container and Packaging Recycling Law. To add to our previous studies of systems for recycling such plastics as raw materials in coke ovens and blast furnaces, we have collected inventory data for other recycling technologies such as gasification for ammonia production and mechanical recycling of secondary plastic products. We have also collected inventory data on separate refuse collection by several municipalities. Using these data, we have assessed the current status of CO_2 emissions from different recycling systems.

The institutional and legislative aspects of recycling systems at various spatial scales are also our concerns. In this regard, this year we measured the effectiveness of the Japanese law governing the recycling of home electrical appliances. On an international scale, by using field surveys we investigated the status of trans-boundary movement of recyclable resources and recycling activities within Asian countries as well as their environmental implications (Fig. 1), and we discussed our findings at an international meeting hosted by NIES in December 2004.

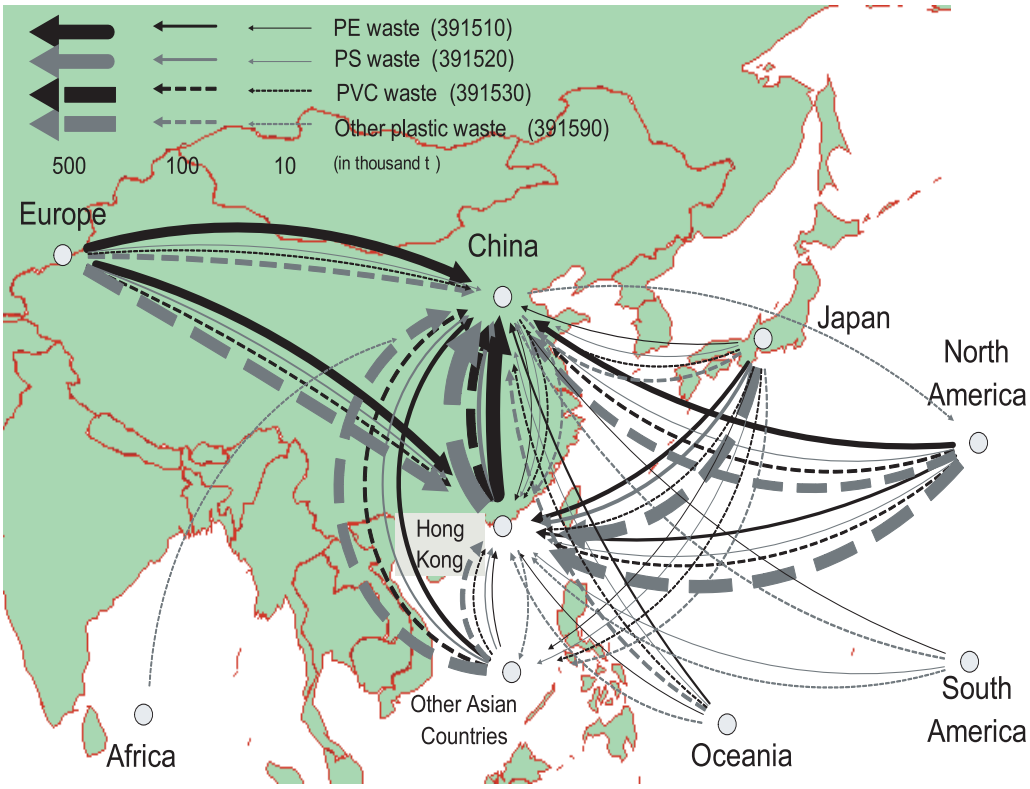


Fig. 1
Material flows of plastic waste among Japan, China, and Hong Kong in 2004.

Some geographic factors, such as the patterns of migration of wastes or resources and the locations of facilities, are important for proper diagnosis of the state of such regional material cycle systems. We have proposed a new Net Transport indicator for evaluating the "waste" of material exchange between certain regions. Incoming and outgoing wastes related to production activity, and their added values in a certain region can be measured by using our improved waste input–output table framework. We used LCA to estimate the environmental impact of transport for waste wood recycling. A location force model for waste and material management facilities was developed to quantify the environmental, geographic, social, and economic forces influencing the siting of these facilities.

In addition, to assess the safety and effective use of recycled products, we investigated the leachability of toxic metals from secondary products made from recycled materials such as slag materials . In particular, using accelerated aging tests, we experimentally confirmed the effect on leachability of the deterioration in quality of the secondary products posed by changes in the conditions of the external environment. We also conducted basic studies of both bioassay methods and methods of removing heavy metals from carbonized waste wood. Moreover, we studied the application of charcoal boards to reduce concentrations of VOCs (volatile organic compounds) in indoor air.

(2) Material Cycle Technologies

We have been investigating the technical solutions required for the proper disposal of wastes and for a sound material-cycle society, in terms of thermal as well as biological processes.

Using ash samples thermally heated (300˚C) in a tube reactor, we experimentally studied the potential for formation of brominated dioxins (PBDD/DFs), chlorinated-brominated dioxins (PXDD/DFs), and chlorinated dioxins (PCDD/DFs). PXDD/DFs were present at considerable concentrations in the effluent gas, suggesting the de novo synthesis of these brominated compounds. Also, we have developed a technique of monitoring various halogenated organics in flue gases on the basis of studies of the basic characteristics of these compounds and measurements of actual incinerator flue gases. This technical research will be extended so that we can assess the entire process of thermal disposal of solid wastes.

In recent years, it has been verified that hydrogen-rich synthesis gas can be successfully produced from waste wood via high-temperature gasification and reforming, a process by which synthesis gas with a hydrogen content exceeding 50 vol% is generated by adding appropriate amounts of steam and oxygen at 950˚C. However, for a practical application of this system we need to raise its thermal energy efficiency. We therefore investigated the potential for efficient hydrogen production at lower temperatures by employing 4 kinds of commercial Ni-based catalyst in the reforming process. We investigated the relationships between the hydrogen conversion characteristics and various operating parameters, including the type of catalyst, temperature, steam to carbon ratio, and equivalence ratio, and evaluated the catalytic performances. We also examined the dioxin- and H_2S-synthesis characteristics on the basis of environmental criteria and the tolerance of a fuel cell to be combined. We demonstrated that the presence of alkaline metal oxide in the Ni catalyst enhanced hydrogen conversion performance and reduced levels of tar and H_2S components. Especially, by using an Ni catalyst containing CaO, a synthesis gas with the highest hydrogen concentration (57 vol%) and lowest tar and H_2S concentrations could be generated at a temperature of 750˚C. We verified that hydrogen-rich synthesis gas could be successfully produced by using catalysts in the reforming process, thus enabling the operating temperature to be reduced by 200˚C.

We have built a database of organic wastes in a prefecture on the basis of unit discharge rate data for each industrial category. Substantial progress has been made in developing the database and methods of evaluating organic wastes. For hydrogen production from organic waste, process efficiency as high as 25% maximum theoretical yield was achieved over a period of more than 1 month. Analysis of 16S rDNA sequences for bacterial populations indicated that organisms of the genus Clostridium were dominant in both hydrogen fermentation and other acid fermentation reactors. We consider that Clostridium-type organisms play major roles in the production of hydrogen from organic wastes. In addition, we achieved stable product yield and

quality in semi-pilot-scale experiments of lactic acid fermentation from food waste. We are considering the possibility of using fermentation residues as animal feed, thus increasing the feasibility of zero-emission-type waste management.

Accidents accompanying hydrogen sulfide generation in inert waste landfills have become an important issue in recent years. The upper limit of the concentration of H_2S gas that may affect the surrounding environment has been defined for landfills; beyond this limit action must be taken. On the basis of this definition, we have proposed countermeasures for landfills that have already closed, are in operation, or are planned for the future. Moreover, we conducted field-scale experiments to investigate how to accelerate landfill stabilization; the gas and leachate quality in an aerobic landfill bioreactor indicated that aerobic landfill bioreactor technology is effective and promising. Leaching tests and respirometric experiments have confirmed that such technology contributes to the acceleration of stabilization. We have developed a site-characterization approach consisting of the use of boreholes and test pits to determine the potential environmental impacts of landfill mining projects. The results of a case study indicated that emissions of dust, odor, and gaseous pollutants would potentially be low, but microbial agents might be released during full-scale excavation and processing of mined wastes. It has been proposed that monitoring and control of microbial agents be included in monitoring plans. Furthermore, we are developing tools for evaluating emissions of global warming gases from landfills and investigating their applicability in full-scale landfills, especially in developing countries.

We have developed an on-site domestic wastewater treatment system, the advanced Johkasou, which can purify water to less than 10 $mg \cdot L^{-1}$ BOD, 10 $mg \cdot L^{-1}$ T-N, and 1 $mg \cdot L^{-1}$ T-P. In particular, we investigated phosphorus removal by use of phosphorus-specific adsorbent composed of zirconium ferrite and determined the optimum conditions for phosphorus adsorption, dephosphorization from adsorbent and recovery of phosphorus. We investigated the germination and growth characteristics of edible plants such as komatsuna (a popular leafy green Japanese vegetable) to show the effect of the recovered phosphate crystal as the fertilizer; komatsuna was able to grow in soils to which we had added phosphate crystal and the effect was the same or more than reagent sodium phosphate. This result suggests the possibility of recycling the recovered phosphorus. We are now developing technologies for hydrogen recovery from biomass and wastes, and we have developed a continuous hydrogen fermentation technology intended for biomass wastes such as garbage (Fig. 2). Digested sludge was heat-pretreared at 70˚C and used as a seed microorganism. Hydrogen fermentation was promoted efficiently under conditions of appropriate hydraulic retention time, pH, and organic loading, and by using molecular biology methods such as FISH (Fluorescence in situ hybridization) and PCR (Polymerase Chain Reaction) we found that hydrogen fermentation bacteria belonging to the genus *Clostridium* were dominant in the microbial community. The hydrogen production efficiency was 70% to 80% of the theoretical value.

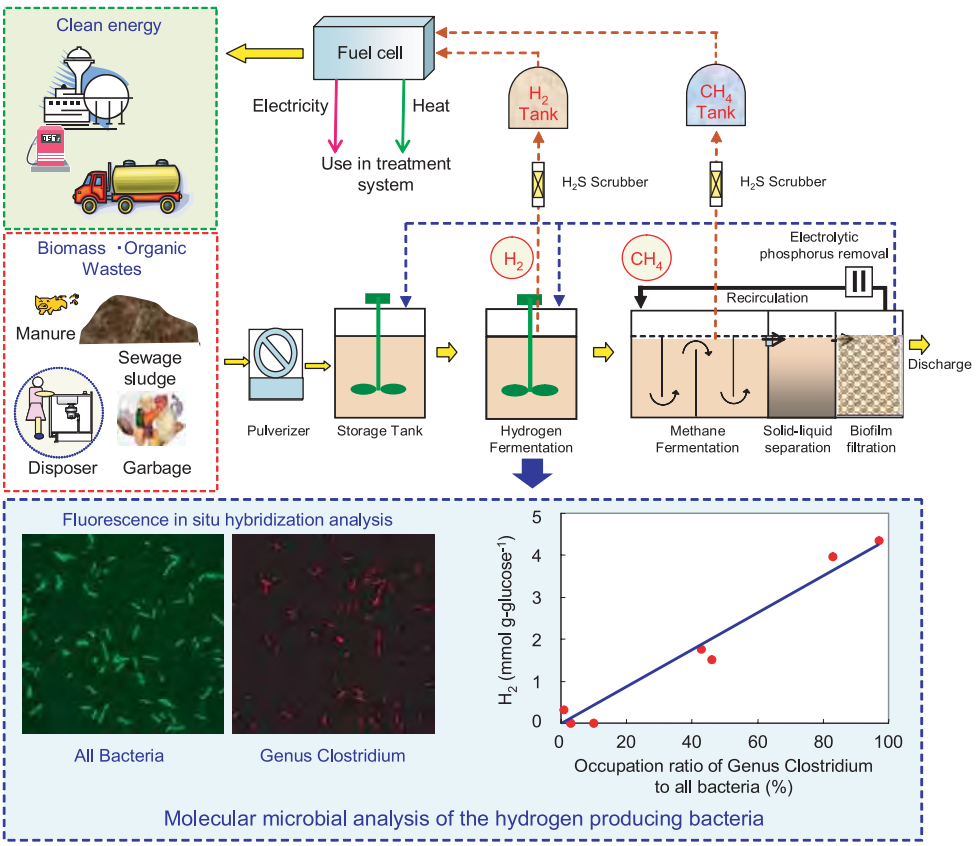


Fig. 2
Development of a hydrogen–methane continuous fermentation process

(3) Material Cycles and Risk Management

Risk management of brominated flame retardants

Identification of major emission sources and compilation of a reliable emission inventory are important in the risk management of brominated flame retardants (BFRs). This year, we performed a mass balance analysis of BFRs in a treatment process for automobile shredder residues (ASRs) as a possible source of BFR emissions; little information on the behavior of BFRs in this process was available owing to the difficulty of performing such surveys. On the basis of many findings, including those of the ASR study, we also compiled an estimated emission inventory for 1 target compound in BFRs.

First, before we performed the mass balance analysis, we developed a sampling and pretreatment method for ASR samples that were both complex and inhomogeneous. We then used this method in the mass balance analysis of a pilot-scale ASR melting process. Polybrominated diphenyl ethers (PBDEs) and tetrabromobisphenol A (TBBP-A) were detected in the ASR at levels of about 10 to 100 ppm. Polybrominated dibenzodioxins/dibenzofurans (PBDD/DFs) were also detected in these samples. The mass balance analysis revealed that more than 99.95% of BFRs and PBDD/DFs were destroyed in the melting process (Fig. 3).

Mass- balance of brominaated compounds in a ASR melting process. Unit:[ng/kg-ASR]

	Input ASR	Output Flue gas	Fly ash	Slag	Metal	Total output	Destruction rate (%)
PCDDs /DFs	970	1.7	4,300	71	140	4,500	<0
Co-PCBs	30,000	1.8	200	7.1	3.7	210	99.3
PBDDs /DFs	30,000	2.2	11	-	-	14	99.95
MoBPCDDs /DFs	-	-	1,900	-	4	1,900	<0
PBDEs	310,000,000	-	120	26	25	170	99.99995
TBBP-A	15,000,000	310	13	13	18	350	99.998
PCBs	270,000	29	960	24	18	1,000	99.6

Fig. 3
Mass balance of brominated compounds in an ASR melting process. Units: ng/kg-ASR.

Next, we combined these results with other emission factors for several processes to compile a tentative emission inventory for Decabromodiphenyether (DeBDE). The atmospheric emissions of DeBDE from the processes of compounding of BFRs, recycling of end-of-life home electrical appliances, and incineration of waste were 0.7, 2.0, and 18 kg/year, respectively. On the other hand, the estimated emission of DeBDE on the basis of environmental levels was 1 to 7 t/year for Japan. The gap between these two emission estimates suggests the importance of unknown sources.

Monitoring of non-volatile and/or polar chemicals in wastes by using liquid chromatography/mass spectrometry (LC/MS)

To comprehensively measure non-volatile and/or polar chemicals of interest for risk management we are developing LC/MS-related analytical methodologies. These consist of accurate determinations of target chemicals, screenings of high priority chemicals, and elemental composition elucidations for identifying unknown organic pollutants. A method that simultaneously screens 78 pollutants chosen as Pollutant Release and Transfer Register (PRTR) chemicals in leachates and soil extracts has been developed for these high-priority chemical screenings. To overcome a serious problem, namely the fact that the LC-MS spectrum gives poor information for identifying unknown chemicals, we have developed an ECE method that uses using accurate masses obtained by LC/ time of flight MS and LC/ quadra pole-TOF MS/ MS. With this method, the number of elemental composition candidates for 72% of every unknown chemical with molecular weights of up to 410 could be narrowed down to 5 or fewer, leading to the creation of a new unknown chemical search system based on ECE.

Comparison of bioassay and chemical analysis—TEQ monitoring during the processes of chemical destruction of PCBs

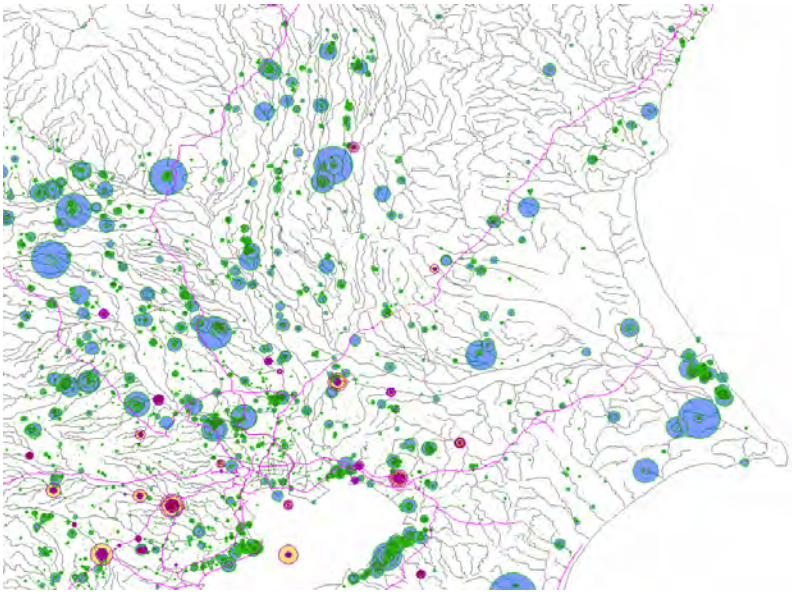
We have successfully applied a cell-based Ah receptor bioassay (CALUX) to monitoring of the fate of dioxin-like compounds during the chemical dechlorination of PCBs to meet demands for a risk assessment method and a screening method. CALUX-TEQ and WHO-TEQ (obtained by chemical analysis) values of PCB-treated samples during photolysis by ultraviolet irradiation (UV); catalytic hydrodechlorination with carbon-supported palladium; dechlorination with potassium

t-butyloxide; or sodium dispersion were obtained and compared in 1 common scale. All the chemical PCB treatment methods reduced WHO-TEQ values by an order of up to 10^{-1} pg/g or less in the final treated oil samples, which achieved the PCB treatment standard. The corresponding CALUX-TEQ values for the samples were 1 pg/g or less, and a consistent correlation between WHO-TEQ and CALUX-TEQ values was observed. The CALUX results suggested that dioxin-like activity caused by reaction byproducts was not present in the oil samples treated by the PCB chemical treatments investigated.

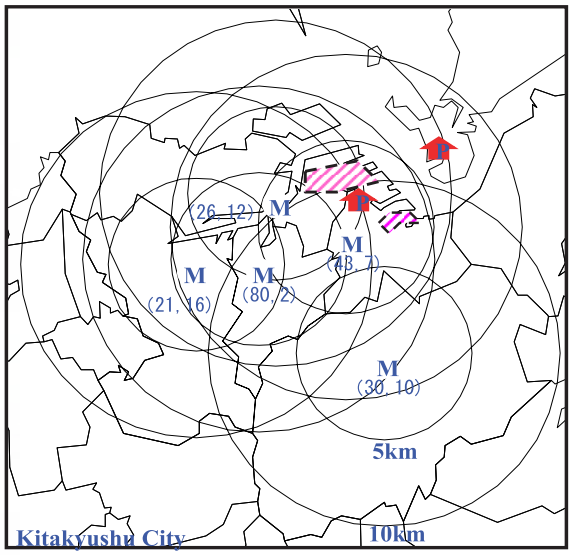
Destruction of coplanar PCBs by 3 methods

To confirm that PCB destruction systems are being managed appropriately, it is important not only to ascertain the disappearance of PCBs, but also to check for the absence of other harmful byproducts in the degradation process—especially coplanar PCBs—that have dioxin-like toxicity. We determined whether or not coplanar PCBs were destroyed and/or produced under the following PCB destruction processes: photochemical dechlorination (PCD), catalytic hydro-dechlorination over carbon-supported palladium (CHD), and sodium dispersion (SD). When 3,3',4,4',5-PeCB (#126) as an example of a non-ortho congener was destroyed by the 3 methods, total TEQ (toxicity equivalent quantity) immediately decreased. When 2,3',4,4',5-PeCB (#118) as a mono-ortho congener was destroyed by CHD or SD, total TEQ also decreased immediately. In the case of the destruction of #118 by PCD, TEQ originating from 3,3',4,4'-TeCB (#77) increased at the beginning of the experiment because #77 was produced mainly by ortho-dechlorination of #126. The TEQ, however, gradually decreased with the degradation of #77 and finally reached zero. In this way, we confirmed the safety of 3 typical methods. These results are expected to be very useful for the promotion of waste PCB treatments.

Research Center for Environmental Risk



(a)



(b)

(a) Example of output of a GIS system used for chemical risk assessment. (b) Comparison of monitoring data for chromium in ambient air with emission data reported in the Pollutant Release and Transfer Register. Example of an area where high concentrations (ng/m^3, rank in Japan) were observed, but the reported level of emission was small. (M: monitoring sites, P: emission sites)

This Center promotes research projects on environmental risk assessment. Currently, there are 7 project themes, covering the development of methodologies for: 1) assessment of exposure to environmental risk in light of exposure variability, 2) exposure assessment on the basis of limited information, 3) assessment of health risks in light of individual variations in susceptibility to chemical substances, 4) bioassay systems for environmental monitoring, 5) assessment of health risks from concurrent exposure to a number of chemical substances, 6) assessment of ecological risk of chemicals on the basis of their toxicity to individual organisms, and 7) communication of environmental risks.

Below are brief descriptions of some of the important results of these projects for 2004.

Development of a methodology to assess exposure on the basis of limited information

As part of this sub-theme, we built numerical models that could predict the concentration of a chemical in the environment from limited information. We developed a 1-dimensional unsteady-flow river model using unsteady flow/advection–diffusion; a steady flow system with a branched river structure; non-equivalent steady-state multimedia model, MuSEM, coded into a spreadsheet (MS Excel); coupled 3-dimensional hydrodynamic and ecotoxicological Tokyo Bay model.

This financial year, we performed additional verification studies of our Tokyo Bay model by comparing measured surface and bottom water concentrations of nonylphenol in Tokyo Bay with simulated values (Fig. 1). The simulated results for dissolved nonylphenol were well correlated with the observed values (r = 0.7707). The results of a sensitivity analysis showed that biodegradation rate was the most important parameter determining the concentrations of dissolved nonylphenol.

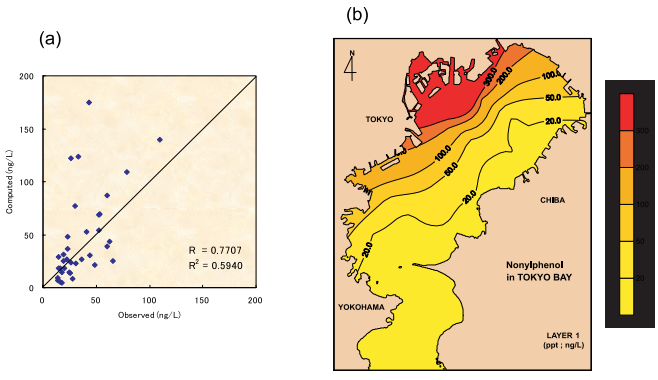


Fig. 1
Comparison of observed and simulated nonylphenol concentrations in Tokyo Bay.
(a) correlation between observed and predicted dissolved nonylphenol (ppt; ng/L) concentrations;
(b) simulated distribution of nonylphenol(ppt; ng/L) in the model area.

It is a basic principle of statistics that the reliability of estimations should improve with an increase in sample number. This tendency of improved reliability, however, is not reflected in the methods widely used to analyze datasets with non-detected observations. We developed a statistical method of estimating the confidence intervals of percentiles for environmental concentrations predicted by using environmental monitoring datasets where some observations are below the limits of detection; we used Monte Carlo simulation on the assumption that the environmental monitoring data fitted a lognormal distribution. This method, in which the estimated confidence

intervals are affected by sample size and detection rate, is more reliable than the usual methods of monitoring samples. We confirmed the validity of this method using environmental monitoring data for bisphenol A, and evaluated the annual variation of nonylphenol concentrations in Japanese rivers (Fig. 2).

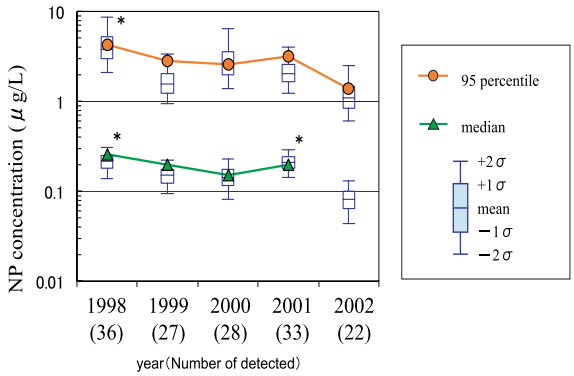


Fig. 2
Confidence intervals of nonylphenol (NP) concentration in Japanese river waters, as estimated by the Monte Carlo method (*statistically significant compared with 2002 data, $P = 0.05$).

Development of a methodology to assess exposure variability in humans and ecosystems

Environmental exposure to chemicals apparently has significant variability in terms of time, space, and other factors. We developed a geo-referenced and spatially-resolved multimedia fate model, G-CIEMS (Grid-Catchment Integrated Modeling System) using GIS databases. The model combines the methodologies of a well-developed multimedia fate model and geo-referenced river models to simulate multimedia fate processes among air, soil, rivers, lakes, sediments, and sea areas with the geographical reality of the river-networking structure under Japanese environmental conditions. The basic geographical resolution was around 5 × 5 km for all media, with a different geographical shape depending on each medium.

We performed case studies in dioxins, VOCs, and nonylphenol until this year. The case studies estimated the spatial variability of the target compounds by using the G-CIEMS model, PRTR (Pollutant Release and Transfer Register) release estimation data for Japan, and selected monitoring data. The results show that the possible range of exposure distribution was several orders of magnitude in Japan. Our analysis revealed that major exposure of the human population may occur at the higher end of the distribution of environmental levels. This observation suggests the key importance of consideration of exposure distribution in performing more accurate exposure assessment.

We studied exposure assessment of dioxins in seafood using production statistics for fish-catches and nationwide fish monitoring data. The results of this study will be to assess the distribution of exposure by the seafood route in combination with the spatially resolved G-CIEMS approach.

Development of a methodology to assess health risks in light of individual variations in susceptibility to chemicals

It is known that polymorphism in some enzyme genes determines the susceptibility of individuals to environmental toxicants. Inorganic arsenicals are worldwide water

contaminants and have been reported to cause skin and urinary bladder cancers. We have been investigating single nucleotide polymorphisms (SNPs) of arsenic methyltransferase Cyt19, because Cyt19 has been reported to be an arsenic methyltransferase and to mediate conversion of inorganic arsenicals to monomethylarsonic acid (MMA) and of MMA to dimethylarsinic acid (DMA) in the presence of glutathione. However, so far, we have not found SNPs in this enzyme gene sequence in humans. The SNP study of the Cyt19 gene sequence is to continue. We also investigated the precise mechanism of detoxification of arsenicals using recombinant rat and human Cyt19.

Development of bioassay systems for environmental monitoring

Bioassay methods are believed to be useful for identifying the hazardous effects of complex mixtures of chemical substances in the environment. To build bioassay systems that could estimate the total impact of chemicals in the environment, we have been evaluating the *in vivo* mutagenicity of diesel exhaust (DE) and its components as a model for a complex mixture of chemicals in ambient air.

Already, we have shown that the frequency of mutations in the lungs of *gpt* delta transgenic mice increases with the duration of DE exposure. As benzo[*a*]pyrene (B[*a*]P) (Fig. 3) and 1,6-dinitropyrene (1,6-DNP) are potent mutagens in DE, we estimated the *in vivo* mutagenicity of these agents in the lung by intratracheal instillation. The *in vivo* mutagenic potency (mutant frequency per dose) of 1,6-DNP was higher than that of B[*a*]P. The positions of mutation hotspots induced by DE on the gpt gene were almost identical to those induced by 1,6-DNP instillation but were different from those induced by B[*a*]P instillation.

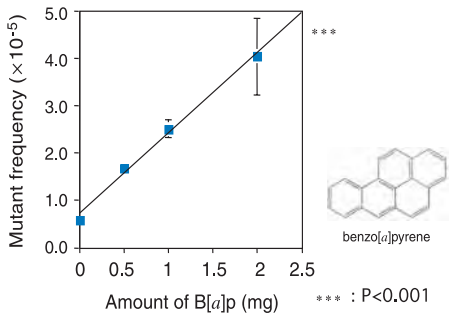


Fig. 3
Frequency of mutations in the lungs of *gpt* delta transgenic mice exposed to benzo[*a*]pyrene

To determine the fraction in diesel exhaust particles (DEP) that causes mutations, DEP or its extract was instilled into the lungs via the trachea. Both DEP and DEP extract dose-dependently and linearly increased the frequency of mutations, and the mutagenicity of DEP was derived mainly from the compounds in the DEP extract. We have obtained parameters for the *in vivo* mutagenicity induced by environmental mutagens, and these parameters are expected to contribute to assessments of the risk of adverse effects (cancer) suffered in response to chemicals in the environment.

New attempt to establish a quantitative structure–activity relationship for chemicals with aquatic toxicity

The quantitative structure–activity relationship (QSAR) has become a powerful theoretical tool for the prediction of chemical toxicity on the basis of molecular

descriptors. We gathered data on the ecological hazards of chemicals from several existing databases and references. The data were compiled and analyzed to examine intra- and interspecies variations in sensitivity to chemicals and to clarify the relationship between aquatic toxicity and chemical structure.

This study deals with the classification of acute toxicity predictions on the basis of fragments and descriptors related to the mode of action of the toxicity. We built several QSAR models and investigated the definition of domain identifications for QSAR modeling in consideration of functional cluster, mode of toxic action, and relationship between descriptor variables and toxicity. This technical approach was applied to 96h LC_{50} values for 2 fish species (fathead minnow and medaka) by using a dataset of more than 600 chemicals investigated by the Japanese Ministry of the Environment or selected from the literature (Fig. 4).

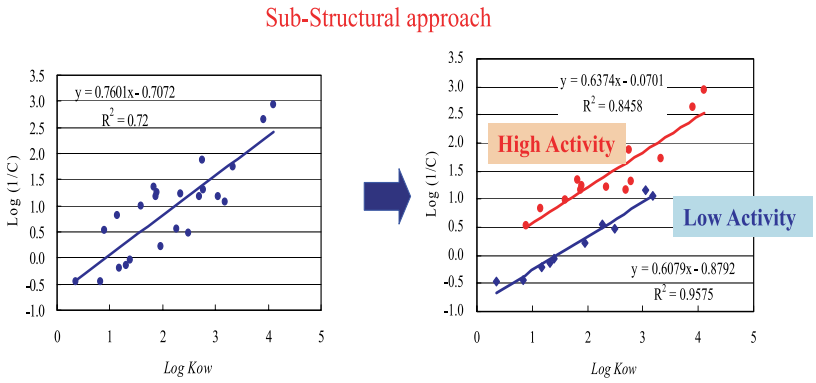


Fig. 4
Example of application of a sub-structural approach to phenols using the 96h LC_{50}; experimental values in 2 fish species (fathead minnow and medaka) were used as base data

The 11 established QSAR models of the classified categories describe the relationship between toxicity and the logarithm of the octanol–water partition coefficient (log Kow). However, we found that the predictions of toxicity of categories that included large numbers of reactive chemicals (e.g. aldehydes) required a multiple regression model using additional descriptors or non-linear models. The results of the external validation study showed that the r^2 value between prediction and measurement was 0.85, whereas the r^2 value in the ecological structure–activity relationship (ECOSAR) model was 0.63. This study suggested that chemical classification using mode of action of toxicity and selection of descriptors and prediction algorithms is essential in predicting aquatic toxicity using the QSAR model.

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

We assessed a method of testing using higher aquatic plants to develop a new OECD test, Guideline 221: *Lemna sp.* growth inhibition test, which was endorsed by the 17th WNT in April 2004. In this study, we performed several experiments to complete the draft of a standard procedure for testing general or low-solubility chemical substances. First we considered the measurement variables. The growth of the plant was estimated on the basis of several different measurements, such as the number of fronds, wet weight, and frond area. The relationships among these data were analyzed statistically to determine which measurement data were essential and relevant to descriptions of the test results. In the test of 3,5-dichlorophenol, which was recommended as a reference item in the test guideline, the different toxicity values—

as measured by the concentration at which 50% growth inhibition was observed (EC_{50})—were estimated from each set of measurement data. The differences among toxicity values were not large. The lowest EC_{50} was driven from the frond area, followed by dry weight. The number of fronds was convenient to measure but may not be adequate, so we recommend that it be used in combination with several other selected measurements.

We tested a procedure for testing with low-solubility chemicals. A semi-static exposure system and a flow-through exposure system were compared in the *Lemna* test. The growth rates of *Lemna* under each test condition did not differ if the test medium was renewed more than 3 times during the 7 days of the test period. Because the result depended on the stability of the test substance in water, the procedure of more frequent renewal or flow-through was acceptable.
We also performed experiments with colored substances, which are regarded as difficult to test in algal toxicity tests because they absorb light required for photosynthesis in the water column. The growth of *Lemna* was not affected by the color. The toxicity of colored chemicals can be estimated with the *Lemna* test more easily and accurately than with an algal test.

Chemicals database

To promote chemical management based on risk communication, we are trying to provide the public with adequate risk-related information via a web-based database through the Internet. So far, we have developed the WebKis-Plus chemical database, which includes pesticide structures and quantities of shipments in each prefecture, an Environmental Fate Model database, and the EnvMethod environmental analytical methods database (Fig. 5).
This financial year, we collected and collated ADIs (acceptable daily intakes) for agricultural chemicals (including pesticides, veterinary drugs, and feed additives) selected mainly from about 670 chemicals listed in the so-called “positive list system” that the Ministry of Health, Labor and Welfare (MHLW) intends to implement. For reference we used MHLW, JMPR (Joint Meeting on Pesticide Residues), and JECFA (Joint FAO/WHO Expert Committee on Food Additives) data.

These data will be linked to the WebKis-Plus chemical database by CAS (Chemical Abstract Service) number.

Fig. 5
Frequency of mutations in the lungs of gpt delta transgenic mice exposed to benzo[*a*]pyreneFig. 4
Example of application of a sub-structural approach to phenols using the 96-h LC_{50}; experimental values in 2 fish species (fathead minnow and medaka) were used as base data

Social and Environmental Systems Division

A typical reef island of New Caledonia

Field measurement of vegetation reflection of a reef island of New Caledonia

Environmental problems can 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 can threaten our daily lives, well-being, and socioeconomic activities. Therefore, the human and societal dimensions of environmental change are of the utmost importance for environmental protection and conservation. In this context, the Social and Environmental Systems Division is concerned primarily with present and future interactions between social and environmental systems.

The Division consists of 5 research sections: Environmental Economics, Resources Management, Environmental Planning, Information Processing and Analysis, and Integrated Assessment Modeling. In addition, there is 1 Independent Senior Researcher. In FY 2004, the division conducted the following research.

Environmental Economics Section

(1) People's support for Climate Change Action

Using the results of international comparative public opinion surveys, we analyzed the factors affecting people's support for climate change actions. We found that personal attitudes are significant factors supporting climate change actions. Such attitudes include: 1) seeing environmental issues as future risks in terms of depletion of natural resources; 2) acknowledging future generations as a basis for problem solving; and 3) seeing the need to balance the environment and the economy.

(2) Study of effects of unit pricing on waste generation

Using city-level panel data, we studied the effects of unit pricing on the generation of household wastes. Our main findings were: (a) generation of combustible waste is significantly and negatively correlated with the prices of garbage bags, whereas the generation of noncombustible waste is not significantly correlated, and (b) the price elasticity of combustible waste generation was estimated to be –0.137.

(3) Study of effects of international moves for sustainable development on Japanese domestic policy

We studied the impacts of international moves toward sustainable development on Japanese domestic policymaking on environmental issues. During the decade 1992–2002, Japanese environmental policymaking gradually began to involve many domestic stakeholders, such as the business community, environmental NGOs, and researchers. This change of process has affected the outcomes of policymaking.

Resources Management Section

The Resources Management Section studies methodologies for quantifying the environmental burdens and impacts associated with various socioeconomic activities. (1) Material flow accounting/analysis (MFA) is one of the key tools used for this purpose. Physical input–output tables (PIOT) are designed to describe the flows of natural resources, materials produced, and solid waste and recycled materials. We examined linkages among MFAs and similar analytical tools on various scales (Fig. 1). (2) We analyzed the incentives for, and effects of, adoption of the ISO 14001 environmental management standard by firms in Japan and the USA. We applied models based on economic and political economic theory to help us understand what factors encourage firms to adopt ISO 14001 and how the environmental management systems of these firms work. (3) Another issue was the application of life-cycle assessment (LCA) to the use of underutilized energy sources to reduce

carbon dioxide emissions. (4) We also applied other comprehensive environmental assessment methods, such as conjoint analysis and cost–benefit analysis, to transportation and waste management scenarios.

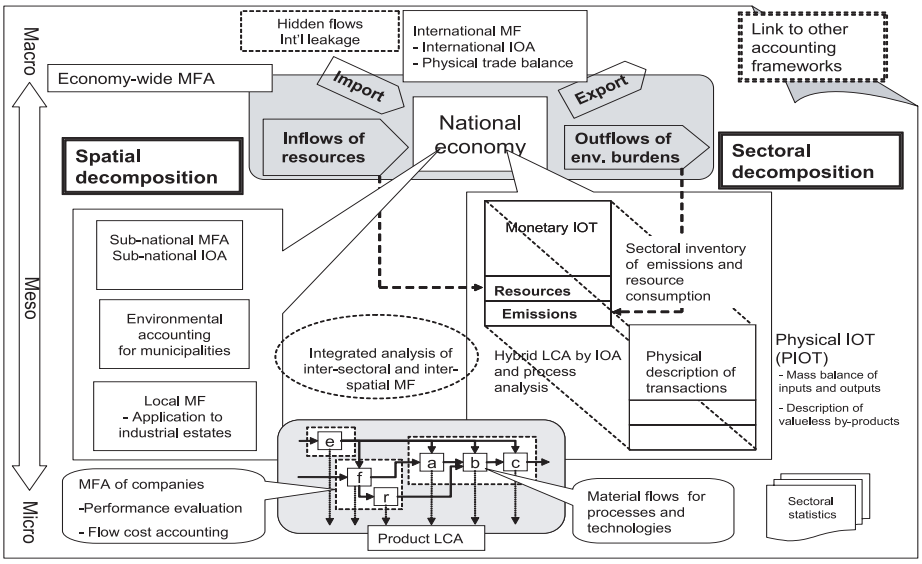


Fig. 1
Material flow accounting/ analysis (MFA) on various scales, and their linkages with input–output analysis (IOA) and life-cycle assessment (LCA). MF: material flow; IOT: input–output tables.

Environmental Planning Section

We study techniques for planning and evaluating environmental conservation policies. Our research includes the setting of local environmental policy goals, as well as the prediction of global warming and assessment of its impacts. In 2004, we conducted the following research. (1) At the annual meeting of the Environmental Science Society, we organized a symposium on the evaluation of ISO 14001, which was introduced 10 years ago and has been expanded to cover municipalities and universities. The merits and demerits of the standard, and its future improvement, were discussed. (2) Urban rehabilitation and reconstruction are inevitable if we are to make cities sustainable. We studied the concept of the compact city as an environmentally friendly city, and compiled a report summarizing the research results. To develop ways of improving the sustainability of the world's large cities, we collected data and developed an urban database that can be used to compare a city against the compact city model. We also participated in, and contributed to, the International Symposium on Asian Megacities and Global Sustainability, organized by the Science Council of Japan.

Information Processing and Analysis Section

Our section promotes comprehensive research on methods of environmental monitoring, numerical simulation analysis, and the processing of information from many kinds of observational data. Examples are the processing and analysis of remote-sensing satellite data on the atmosphere, land, and oceans; the non-destructive and sensitive discrimination of types of bird eggs; and the numerical simulation of diffusion of urban air pollution. We also process and analyze research data generated by the other sections of our Institute . In 2004, we processed information on several special priority research projects, including the evaluation of grassland and coral reef environments by using hyper-spectral sensor data and the investigation of a new method to precisely estimate CO_2 column density from nadir-looking satellite sensor data.

Integrated Assessment Modeling Section

The "Integrated Assessment Model" has been developed to evaluate environmental conservation. This model covers a wide range of environmental problems, economic activities, land-use changes, lifestyle changes, and recycling. It evaluates the impact of environmental conservation measures on the economy. If we are to conserve the future global environment it is essential that we cooperate with developing countries in the Asia-Pacific region, such as China, India, and Thailand. Presently, the priority of environmental conservation in developing countries is much lower than that in developed countries. However, it is essential that developing countries give importance to environmental conservation and include it in their lists of development priorities. We used the Integrated Assessment Model to examine suitable policies for sustainable development in India. The simulation included constraints on natural assets and potential countermeasures to these constraints. The simulation showed that recycling and technology innovation scenarios can be expected to mitigate the loss of GDP caused by policies that reduce the production of industrial wastes. Also, they showed that early investment in land conservation measures could provide substantial national financial benefits. The model was also applied to the issue of carbon tax, which is considered to be an economic incentive to accelerate CO_2 reduction countermeasures.

Report of the Independent Senior Researcher

I investigated the travelogues of early Western visitors to Japan from the time of the first visitor, the Portuguese adventurer Fernão Mendes Pinto in 1543 (*The Pilgrimage*), up until 1900. These visitors appreciated the beauty of the Japanese landscape from the viewpoint of the diversity of plant species and the comparison of these species with European ones. Carl Peter Thunberg, the apprentice of Carl von Linné, arrived in 1775 and described 49 species on the way from Nagasaki to Edo (now Tokyo). He also found a diversity of plant species and coexistence of boreal and tropical plants. Philipp Franz von Siebold, from Germany, arrived in 1822 and described more than 372 species. Sir Ernest Mason Satow, who came from the UK in 1862, described Japanese landscapes more precisely by using his knowledge of taxonomy, based mainly on that of European plants. The descriptions recorded by these travelers were influenced by the popularity of knowledge of taxonomy; thus the beauty of Japan's landscape was clarified by the popularity of plant taxonomy throughout the whole world.

In addition, a report on historical distribution of the "Eight Scenes" in Japan was published (Fig. 2).

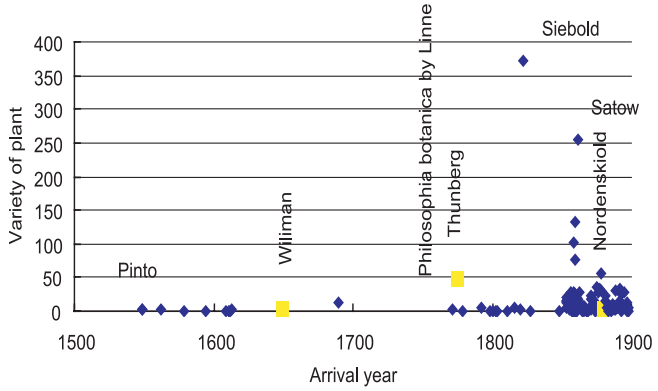
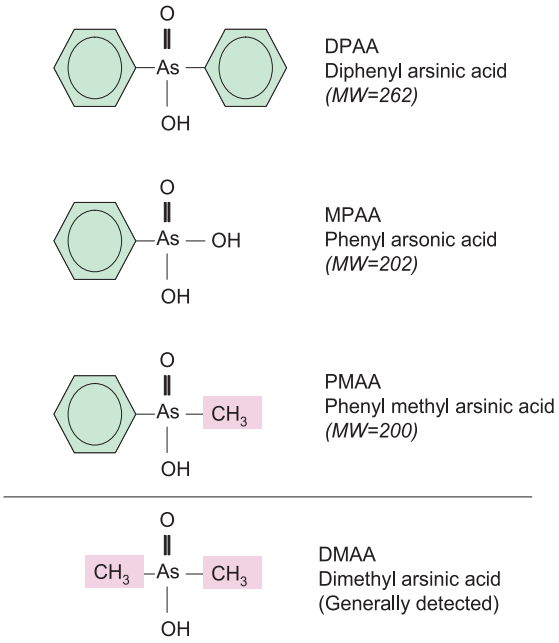
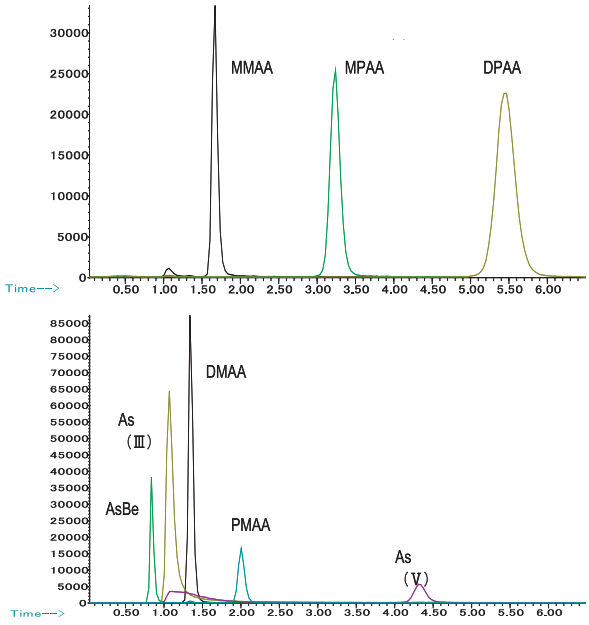


Fig. 2
Historical distribution of the "Eight Scenes" in Japan.

Environmental Chemistry Division



Structures of some phenylated arsenic species detected in the environment.



Separation of major arsenic compounds by HPLC and ICP-MS. Arsenic compounds: As(III): arsenous acid; As(V): arsenic acid; MMAA: monomethylarsonic acid; DMAA: dimethylarsinic acid, MPAA: phenylarsonic acid, DPAA: diphenylarsinic acid, PMAA: phenylmethylarsinic acid, AsBe: arsenobetaine

The Division, with its 4 Research Sections and an Independent Senior Research Scientist, has been developing analytical, bioanalytical, and geochemical methods and revealing various chemical aspects of the environment.

The **Analytical Instrumentation and Methodology Section** has been developing new analytical methods and instrumentation. Development of a compact energy-saving aerosol monitoring system is now in progress. The monitoring system, which is equipped with a small electron gun with a transmissive diamond electron window and an X-ray tube, enables us to determine the concentration and inorganic chemical components of the aerosol mass. The source of the electron beam is a field emitter fabricated by hydrogen plasma etching of a graphite substrate. We also investigated high-resolution TlBr detectors operated at room temperature for X- or gamma rays. A mobile ambient atmospheric monitoring system is also being developed in cooperation with the Environmental Atmospheric Division. The Oceanic Windfarm Project started in 2003 and is now in progress. A fundamental design has been made for a mega-float of about 1000 × 500 m with 11 windmills with a total of 5-MW power generation capacity and a seawater electrolysis system, which will produce electric power and hydrogen. A study of the dynamics of organic carbon transported to the ocean through rivers was started by taking carbon isotope measurements of riverine particulate and dissolved matter. Concentrations of C_2–C_7 non-methane hydrocarbons were monitored hourly in central Tokyo in summer 2004, using an automated gas chromatograph – flame ionization detector (GC-FID) system. This system gave a good presentation of the amount of emissions and demonstrated the important roles that these compounds play as precursors of photochemical oxidants in urban areas.

The **Analytical Quality Assurance Section** has been developing methods of analytical quality control by determining the most appropriate environmental analytical methods and preparing certified reference materials. We investigated methods of sample preparation and high resolution gas chromatography – high resolution mass spectrometry (HRGC-HRMS) analysis of polychlorinated-*p*-dibenzodioxin/furans (PCDD/Fs), co-planar polychlorinated biphenyls (co-PCBs), and polybrominated-*p*-dibenzodioxin/furans (PBDD/Fs) in various environmental samples. We successfully performed analytical quality assurance of environmental PCDD/F monitoring by using the certified environmental reference material NIES CRM-No.25, “Soil 2”. We used liquid chromatography – mass spectrometry (LC-MS) to study the environmental monitoring of perfluorooctane sulfonate (PFOS) and related perfluorochemicals (PFCs), which show similar characteristics to persistent organic pollutants (POPs). We also studied methods of measuring fine particles and volatile organic compounds (VOCs) in the atmosphere. VOCs have been monitored continuously at Tsukuba and Tokyo to establish quality assurance for the automatic sampling gas chromatography – mass spectrometry (GC-MS) instruments and to characterize VOC pollution in metropolitan areas.

The **Environmental Chemodynamics Section** has been performing radiocarbon analyses for environmental studies such as the dating of environmental samples and source apportionment of pollutants by accelerator mass spectrometry (AMS); developing methods of chemical speciation by liquid chromatography – inductively coupled plasma mass spectrometry (LC-ICPMS); determining stable isotopes by isotope ratio mass spectrometry (IRMS); and investigating the application of surface analytical methods such as secondary ion mass spectrometry (SIMS). We demonstrated the imaging of the chemical bonding state of Si in a rock sample by X-ray photoelectron microscopy. Lake Kussharo, the largest caldera lake in Japan, recorded a pH value of four 40 years ago but its pH has become spontaneously neutralized in recent years. We investigated the cause of this neutralization by observing the water and ion balances of the influent and effluent rivers. We also developed a continuous-extraction sampling system for hazardous chemicals and installed it on merchant vessels. Samples of hazardous chemicals in surface seawater were collected by using this sampling system. Furthermore, we used carbon and nitrogen isotope ratios and radiocarbons in collagen to examine the reactions of ancient humans to past environmental changes.

The **Ecological Chemistry Section** has been studying biochemical measurement and the biological effects of chemicals. We conducted an extensive monitoring study of Tokyo Bay in collaboration with the Endocrine Disruptors Research Group and the Laboratory of Intellectual Fundamentals for Environmental Studies. Research on arsenic—especially diphenylarsinic acid (DPAA)—as well as endocrine-disrupting chemicals was continued. We also continued out emergency research in response to the outbreak of carp herpesvirus infection in several locations in Japan, including Lake Kasumigaura. Comparison of water quality and blood physiological data on infected carp caught in many locations in Japan showed no relationship between virus infection and environmental conditions or carp health status. We also continued our research on the initial risk assessment of pharmaceuticals in the aquatic environment by developing both an LC-MS analytical method and a bioassay method, and we applied these methods in assessing the levels of some pharmaceuticals in the real environment.

The Independent Senior Research Scientist continued a global monitoring program for VOCs in the atmosphere. This program was based upon semi-monthly flask sampling and analysis of air from remote sites (Hateruma Island in Okinawa, Cape Ochiishi in Hokkaido, Happo-One near Nagano, Alert in Canada, and Cape Grim in Australia). We found that the tropospheric mixing ratios of hydrofluorocarbons have been rapidly increasing. The rates of increase for the years 2003-2004 were nearly 5 ppt (or 16%) for HFC-134a, and nearly 1 ppt (or 20%) for HFC-152a in northern hemisphere.

We developed a new speciation method for detecting and identifying arsenic species (Fig. 1) in environmental samples in order to identify DPAA and its metabolites or degradation products in the environment (Fig. 2). In this method, we used the same

high performance liquid chromatography (HPLC) condition for both the HPLC/ICP-MS and LC-MS-MS systems so that a new arsenic chemical detected by HPLC/ICP-MS could be characterized by detecting its parent or daughter ions by LC-MS-MS. We demonstrated the presence of a new organoarsenic compound, phenylmethylarsinic acid (PMAA), by this method.

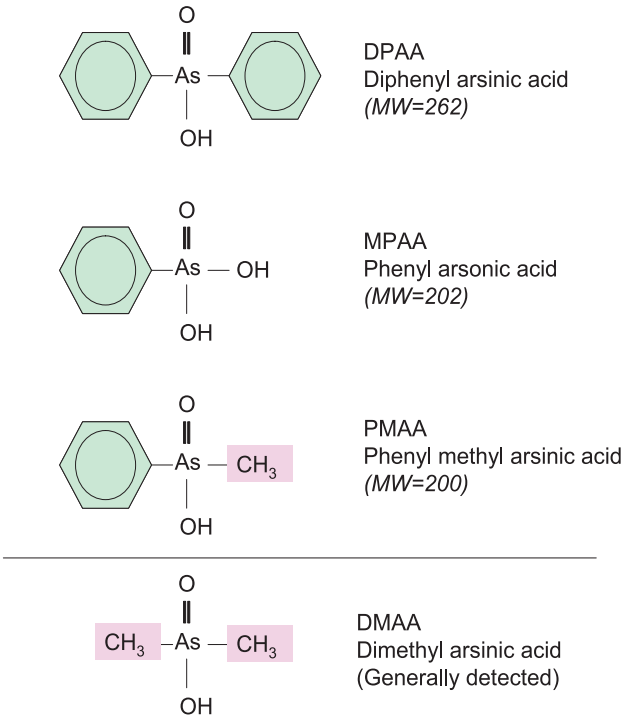


Fig. 1
Structures of some phenylated arsenic species detected in the environment.

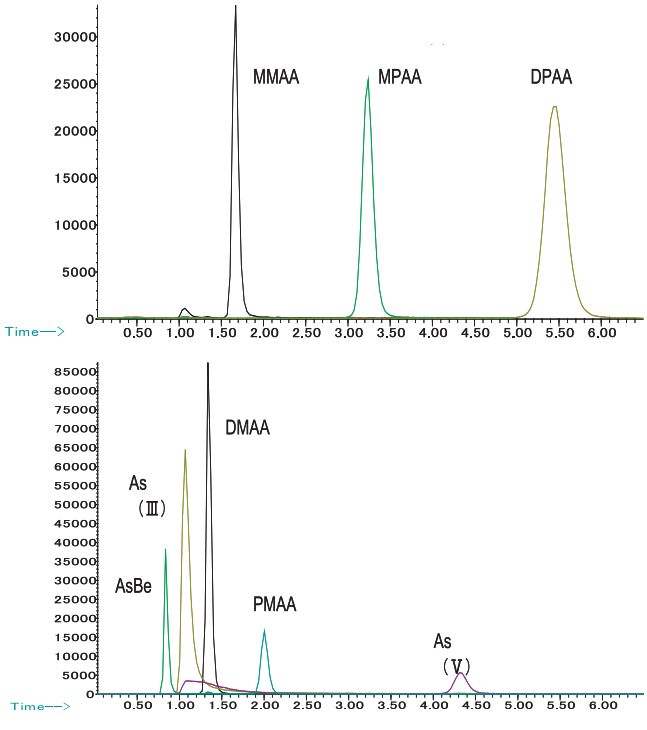


Fig. 2
Separation of major arsenic compounds by HPLC and ICP-MS. Arsenic compounds: As(III): arsenous acid; As(V): arsenic acid; MMAA: monomethylarsonic acid; DMAA: dimethylarsinic acid, MPAA: phenylarsonic acid, DPAA: diphenylarsinic acid, PMAA: phenylmethylarsinic acid, AsBe: arsenobetaine

Environmental Health Sciences Division

Countries and number of people affected by arsenic contamination of drinking water. Thirty-five million people in west Bengal/Bangladesh and two million people in China are reportedly affected by arsenic contamination.

The mission of the Environmental Health Sciences Division is to study the possible effects of harmful environmental chemicals (e.g. dioxins, environmental endocrine disrupters, heavy metals, air pollutants) and physical agents (e.g. heat stress, noise stress, ultraviolet radiation, LED (light-emitting diode) light (blue components), and electromagnetic fields (extremely low frequency)) on human health. We aim to utilize the information obtained from these studies as the scientific basis for risk assessment of these agents, alone or in combination. In this Division we perform both epidemiological and experimental studies. In the latter, we use laboratory animals as experimental models for humans. Although the use of these animals is essential in studying how environmental chemicals affect humans, the importance of alternative experimental models that replace laboratory animals has been recognized. Below, we highlight our progress in several study areas.

In the **Molecular and Cellular Toxicology Section**, we have been studying the toxic effects of dioxins, including the most toxic congener, 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD), focusing on their effects on gene expression and the mechanisms of their organ- and species-specific effects. To explore the genes that are involved in TCDD suppression of antibody production, we used Affymetrix oligonucleotide microarrays to investigate TCDD-induced changes in gene expression in the CD4 T lymphocytes (T cells) and B lymphocytes (B cells) of mice immunized with ovalbumin (OVA). The results revealed characteristic TCDD-induced changes in gene expression in the CD4 T cells and B cells of immunized mice and suggested that inhibition of immunization-induced gene expression and modulation of G protein-linked signaling in CD4 T cells are responsible for the TCDD-induced suppression of antibody production. The toxic effects of TCDD on immune cells have been shown to be caused by activation of a transcription factor, the arylhydrocarbon receptor (AhR). To investigate the function of AhR activation in T cells, we generated transgenic (Tg) mice that expressed a constitutively active mutant of AhR (CA-AhR) specifically in T-lineage cells under the regulation of a T cell-specific CD2 promoter. Studies in these Tg mice indicated that AhR activation in T cells but not in B cells suppressed the OVA immunization-induced increase in numbers of not only T cells but also B cells. These Tg mice will be useful models for investigating the role of activated AhR in T cells. We also generated a Dioxin Responsive Gene Database to assemble the microarray data that have been accumulating in our section and to summarize information on the experiments conducted to study the effects of dioxins. We have made this database available to the public through NIES web page .

In the **Environmental Biodefense Research Section**, we performed 2 studies. To investigate the size-specific effect of ultrafine particles on pulmonary immune responses, translocation to lymph nodes, and chemokine mRNA expression in the lungs and lymph nodes of mice, we instilled 14-nm and 95-nm carbon black (CB) particles intratracheally. Total and differential counts of cells such as macrophages, lymphocytes, and neutrophils in bronchoalveolar lavage (BAL) fluid increased significantly and dose-dependently in mice exposed to 14-nm CB particles. Release of cytokines such as interleukin (IL)-6 and tumor necrosis factor-α enhanced significantly in BAL fluid in mice instilled with 14-nm CB compared with those

given 95-nm particles. Production of macrophage inflammatory protein 1α/CCL-3 protein and mRNA expression also increased in the lungs and lymph nodes of mice given 14-nm particles. These findings indicate that intratracheal instillation of ultrafine CB in mice leads to pulmonary inflammation that is particle size-dependent. In our second study, to evaluate the effect of low-level volatile organic compounds on neuro-immuno interaction, we examined the effect of low-dose toluene on the production of cytokines and chemokines in the spleen and olfactory bulb. The olfactory bulb is one of the key organs for formation of the neuronal memory of chemicals. Expression of IL-4 and IFN-γ mRNAs significantly increased in the spleens of toluene-exposed mice. Immunization with OVA significantly enhanced the expression of CCL-3 mRNA in the olfactory bulbs of mice exposed to toluene. These findings suggest that exposure to low-level toluene may affect the neural and immune network in concert with antigenic stimulation.

In the **Biomarker and Health Indicator Section**, we investigated the metabolic pathways of inorganic arsenicals in mammals (Fig. 1). Inorganic arsenicals are worldwide environmental contaminants, and chronic exposure is known to cause skin lesions, vascular diseases, and cancers. In the metabolism of arsenicals, S-adenosyl-L-methionine (SAM) is required as a methyl group donor and reduced glutathione (GSH) is required as a reducing agent. Until recently, methylation was considered potentially useful as a detoxification process for harmful inorganic arsenicals, since the toxicity of pentavalent methylated arsenicals (monomethylarsonic acid, MMA^{V} and dimethylarsinic acid, DMA^{V}) is much lower than that of inorganic arsenicals. However, the methylation of arsenicals has been reported to be a process of bioactivation, because the toxicity of intermediate metabolites such as MMA^{III} and DMA^{III} was found to be much higher than that of inorganic arsenicals. Analyses by high performance liquid chromatography – inductively coupled plasma mass spectrometry (HPLC-ICP MS) suggested that arsenic triglutathione (ATG) was generated nonenzymatically from iAsIII when GSH was present at concentrations of 2 mM or higher. Human recombinant Cyt19 (an arsenic methyltransferase) catalyzed the transfer of a methyl group from SAM to arsenic and produced monomethyl and dimethyl arsenicals. The methylation of arsenic was catalyzed by Cyt19 only when ATG was present in the reaction mixture. These results suggest that As–GSH complexes are converted to methylated arsenicals by Cyt19. In addition to the metabolism of inorganic arsenicals, we also studied the cytotoxicity of phenyl arsenicals, because diphenylarsinic acid and monophenylarsonic acid were found in high concentrations in the groundwater at Kamisu, in Ibaraki Prefecture, Japan. Trivalent phenylarsenicals were more cytotoxic than pentavalent phenylarsenicals as inorganic arsenicals and their metabolites.

The **Epidemiology and International Health Research Section** conducted a number of epidemiological studies. One was a series of field studies in Japan and China and another was a statistical analysis of trends in various health phenomena, with special reference to environmental factors. With the financial support of the Ministry of the Environment, we conducted field research on the measurement of fine particulate matter ($PM_{2.5}$) using personal $PM_{2.5}$ samplers, and assessed residential exposure to

$PM_{2.5}$ in 7 research areas in Japan. We selected 20 households as participants in each of the 7 cities, and measured $PM_{2.5}$ concentrations inside and outside the participants' houses and personal exposure over 1 week in autumn. As a field survey in the city of Shenyang, in Liaoning Province in China, we conducted health investigations (pulmonary function testing and a questionnaire survey of schoolchildren), environmental monitoring, and exposure assessment of air pollutants (in particular, $PM_{2.5}$). Results from the cities of Fushun and Tieling, where the survey had been conducted in previous years, showed elevated levels of atmospheric pollutants from the combustion of fossil fuels both outdoors and indoors, as well as personal exposure. Pulmonary function values among children were significantly depressed in spring. This result suggests that, in winter, air pollution has subacute effects on pulmonary function. We also conducted research on the effects of heat stress on human health. We established a system of monitoring patients affected by heat shock in 13 major cities, by using an emergency transportation network.

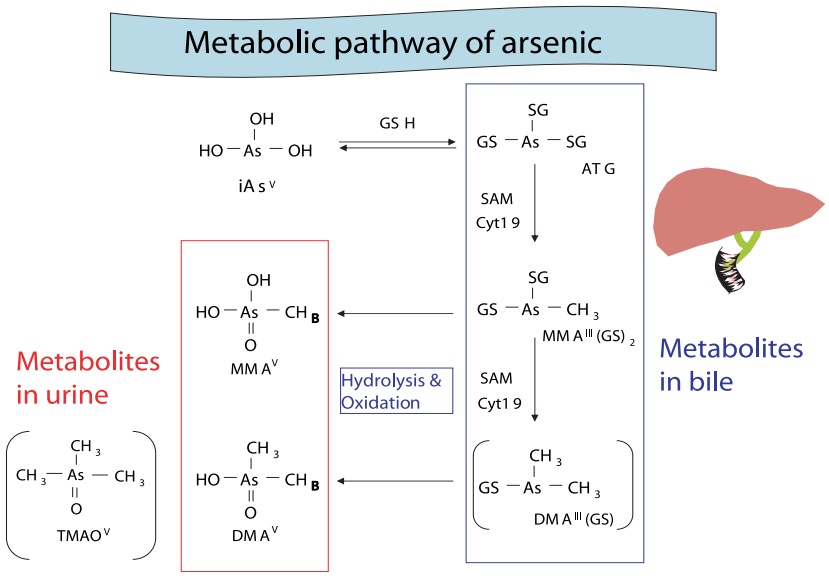


Fig. 1
Pathway of metabolism of inorganic arsenic in the mammalian liver. Arsenate and arsenite are metabolized by an arsenic methyltransferase, Cyt19, in the presence of glutathione (GSH) and S-adenosylmethionine (SAM) and excreted as monomethylarsonic acid (MMA^V) and dimethylarsinic acid (DMA^V) in the urine

Atmospheric Environment Division

「Photo;Y. Takahashi」

View over a field of clouds from the Jungfraujoch in Switzerland.

This Division is conducting research with the aim of understanding and solving atmospheric environmental problems ranging from urban air pollution to global and trans-boundary atmosphere-related issues. The division consists of 4 sections and 1 team: the Atmospheric Physics Section, which conducts research on numerical modeling and data analysis of atmospheric dynamics and climate systems; the Atmospheric Chemical Reaction Section, which conducts research on chemical processes taking place in the atmosphere; the Atmospheric Remote Sensing Section, which conducts research on observations of the atmospheric environment using remote sensing techniques such as lidars (laser radars); the Atmospheric Measurement Section, which conducts field research on natural and anthropogenic trace species; and the Acid Deposition Research Team, which conducts research on trans-boundary air pollutants. Many of the members of this division also work for Special Priority Research Projects such as Climate Change Research, Ozone Layer Research, PM2.5 & DEP Research, and the Center for Global Environmental Research.

Following are brief accounts of some important results of our research in FY 2004.

Validation and future projection of extreme precipitation in a climate model

Extremely heavy precipitation, which may cause floods and consequently serious damage to society, is considered highly important in the context of climate change assessment. We used a relatively high-resolution (~1°) atmospheric general circulation model to simulate the present-day climate, with 2 different assumptions of cumulus parameterization. Although the 2 runs showed comparable performance for annual mean precipitation, one gave much better agreement than the other with satellite-based analysis data for extreme daily precipitation. Accumulation of convectively available potential energy is shown to be important for achieving more realistic intensities of extreme precipitation. This demonstrates that the performance of a climate model for extreme precipitation is strongly dependent on cumulus parameterization, even when the resolution of the model is as high as 1°, but that it can be reasonably good with an adequate choice of cumulus parameterization. A doubled CO_2 experiment was also conducted with the better version of the model. The change in global mean percentage was larger for extreme precipitation than for the annual mean, and this relationship was found to vary regionally (Fig. 1).

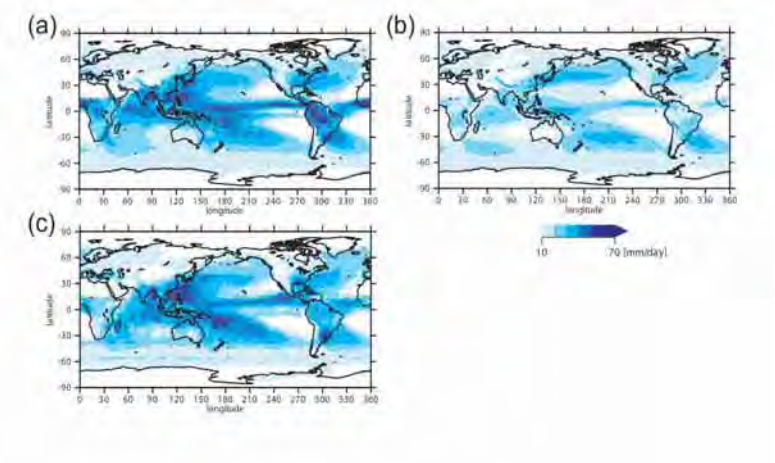


Fig. 1
Geographical distributions of annual 4th-largest daily precipitation event: (a) standard model, (b) experimental model, and (c) observed data.

Evaluation of the atmospheric environment in East Siberia and the Primorsky region in Russia

Wet deposition and gas/aerosol samples were collected annually at 3 sites (Irkutsk, Listvyanka, and Mondy) in East Siberia and at 1 site (Primorskaya) in the Primorsky region. Precipitation was acidified mainly by sulfuric acid. Although sulfate concentrations in precipitation were higher than those in Japan, Europe, and the United States, the quantities of sulfate deposited were smaller because of the low rates of precipitation. Sulfur dioxide and sulfate aerosol were the major components of acidic substances in the test regions. Sulfur dioxide concentration was high in winter at all sites. From trajectory analysis, we found that the winter air mass usually moved from Europe to East Siberia within only 3 days and moved from East Siberia to Japan within 3 days.

Aerial observation of atmospheric pollutants in China

In collaboration with Chinese researchers, we performed aerial observations of aerosols and gaseous pollutants over central China along the Yangtze River (i.e., along the route from Shanghai to Wuhan to Chongqing) to better understand the atmospheric environment of East Asia and the Northwestern Pacific region. Experiments were carried out from 19 May 2004 to 10 June 2004 from a Yun-12, a Chinese twin-engined airplane. A total of 10 flights were made around Shanghai, Wuhan, and Chengdu. On board were an ozone analyzer, an SO_2 analyzer, and an NOx analyzer to measure gaseous pollutants, and a particle sizer, a condensation nucleus counter, PM_{10} and $PM_{2.5}$ samplers, and an aerosol mass monitor for aerosol measurements. High concentrations of SO_2 (up to 40 ppb) were observed near Chongqing and near Nanjing at low altitudes. Local sources of pollutants were clearly seen to affect the atmospheric environment of the area on the basis of the route of transport of air masses, as analyzed by back trajectory calculations.

Continuous measurement of aerosol chemical composition at Cape Hedo, Okinawa

The chemical compositions of aerosols have been monitored continuously with an aerosol mass spectrometer and EC/OC (elemental carbon and organic carbon) monitors at Cape Hedo on Okinawa's main island since October 2003. High concentrations of sulfate have been observed when the air mass comes from the direction of central eastern China, and in that case the ratio of EC to OC is higher. This result suggests that large quantities of sulfur oxides and black (elemental) carbon are emitted simultaneously in eastern China.

We have set up a new monitoring station, the Cape Hedo Atmosphere and Aerosol Monitoring Station (CHAAMS), at Cape Hedo. Comprehensive monitoring of aerosols will be carried out at this observatory (Fig. 2).

Fig. 2
(a) Cape Hedo Atmosphere and Aerosol Monitoring Station (CHAAMS).
(b) Aerosol mass spectrometer being used at the station to observe chemical components of aerosols.

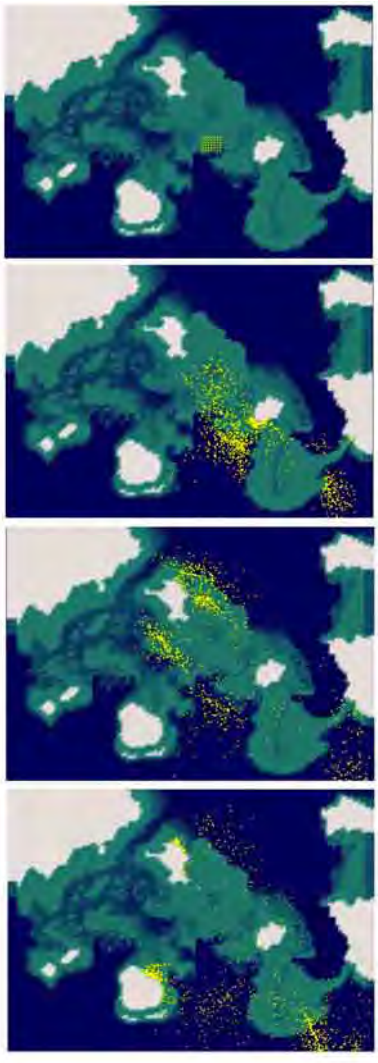
Observation of carbon stable isotope ratio and its variability in soil respiratory CO_2 flux from terrestrial ecosystems

The use of atmospheric measurements of carbon stable isotope ratio ($^{13}C/^{12}C$) in CO_2 to better constrain the atmospheric CO_2 budget requires knowledge of the various processes related to this ratio. Although the decomposition of soil organic matter by heterotrophic respiration is the largest component of CO_2 fluxes from the land to the atmosphere, the $^{13}C/^{12}C$ ratio of heterotrophic respiration in the natural environment had not been measured precisely owing to technical difficulties with both sample collection and elimination of the influence of plant respiration. We developed a sampling system optimized for $^{13}C/^{12}C$ measurement of soil CO_2 efflux, and conducted a 3-year observation at the NIES-Tomakomai Flux Research site. The $^{13}C/^{12}C$ ratio of soil CO_2 efflux showed significant seasonal variation regardless of whether or not plant respiration was eliminated. The observed seasonal amplitude of greater than 1‰ for $^{13}C/^{12}C$ contrasted remarkably with previous model estimates (< 0.3‰). The seasonal pattern of the $^{13}C/^{12}C$ ratio also showed an obvious difference from the model predictions. These findings from the observational study will help to reduce the uncertainty in estimates of the global CO_2 budget via improvements in model analyses.

Observations of Asian dust and air pollution aerosols using a network of automated lidars

A network of automated 2-wavelength dual-polarization lidars has been formed in collaboration with universities and research institutes in China, Korea, and Japan. At present, lidars are operated continuously at 12 locations, including Beijing, Hohhot, Suwon, Nagasaki, Toyama, Matsue, and Tsukuba. A lidar data analysis method has been developed for separately estimating the extinction coefficient profiles of non-spherical particles (Asian dust) and spherical aerosols (mostly air-pollution aerosols). By using this method, movement of Asian dust and anthropogenic aerosols was clearly revealed. The results showed, for example, that regional-scale air pollution significantly affected air quality in Beijing. In contrast, regional pollution features were not very marked in Hohhot, which is located approximately 450 km west of Beijing. The lidar network data were used for validation of chemical transport models.

Water and Soil Environment Division



Simulated dispersion of coral eggs (yellow dots) spawned from the central part of Sekisei Coral Lagoon, in southwestern Japan. The lagoon is surrounded by the islands of Ishigaki (right), Iriomote (upper left), and Kuroshima (bottom left). The white areas are land, and the light-green and dark-blue areas are shallow (< 10 m) and deep (> 10 m) seas, respectively. The 4 plates from top to bottom show the time of spawning, ebb time (tidal flow from the East China Sea to the Pacific Ocean), flood time (reverse to ebb time), and the next ebb time, respectively.

Water—in precipitation, rivers, lakes, seas, and soil—is vital for our lives. Once the environment has been polluted, the time and cost needed for its restoration are enormous. Our Division undertakes research from a variety of approaches on the environmental pollution and ecological changes that occur via the media of water and soil.

Application of microbial ecology to environmental management

Microorganisms play a major part in various important biogeochemical transformations and water treatment, such as mineralization of organic compounds and degradation of pollutants. We are studying the community structure and biological activity of microorganisms in the natural environment and their application to water treatment.

We studied the geological characteristics of bacterioplankton in the eutrophic Lake Kasumigaura by using 16S rDNA analysis based on denaturing gradient gel electrophoresis (DGGE). The DGGE analyses were carried out on water samples collected from the littoral region at Nishiura. Comparison of the band profiles indicated that the community structure in branching bays was different from those at other sites. We presume that the influx of nutrients and the retention of water affect the behavior of each species of microorganism.

We have also been studying the use of biological processes for preservation of the aquatic environment. Methane fermentation is an economical process for treating high concentrations of organic wastes and wastewater. However, most wastewaters are discharged at ambient temperatures (10–25°C) and have low organic concentrations of less than 1 g-CODCr·L^{-1} (chemical oxygen demand—chromium). Under these conditions, which are unsuitable for methane fermentation, it is difficult to maintain the activity and physical properties of methanogenic sludge. We examined the use of an anaerobic bioreactor seeded with a methanogenic biofilm for the treatment of low-strength (0.6–0.8 g-CODCr·L^{-1}) wastewater at 20 °C. An appropriate upflow velocity was achieved by recirculating the effluent which improved the accessibility of wastewater to the biofilm. As a result, the reactor exhibited superior process performance (treatment time 1.5 h, COD loading of 12 kg-CODCr·m^{-3}·day^{-1}) owing to the maintenance of a high concentration of biofilm with high activity.

Migration and change in chemical fractions of rare metal contaminants (Ag, In, Sn, Sb, and Bi) in soil

Recently, pollution from lead leaching out of solder in discarded electrical appliances has become an important environmental problem. Therefore, in the near future, Pb solder will be replaced by Pb-free solders containing other metals such as Ag, In, Sb, and Bi. However, information on the behavior of such metals in the environment (especially in soil) is extremely limited. We therefore investigated their migration and the change in the chemical fractions in soil. Ag, In, Sn, Sb, and Bi were added to the surface of an Andosol, Cambisol, Fluvisol, or Regosol in columns; the soils were then exposed to precipitation for 18 months. The distributions of the total concentrations and the chemical fractions of the metals (by 8-step sequential

extraction) were then analyzed. Most of the metals were retained in the uppermost (0–2 cm) soil layers, but small portions moved to the sub-layers. The major chemical fractions (> 10% by proportion) of the metals were residual, H_2O_2 extractable organic-bound (H_2O_2-Org), and metal-organic complex-bound (Me-Org) fractions in the case of Ag; Me-Org, residual, carbonate-bound, and H_2O_2-Org fractions in the case of In; residual, Me-Org, amorphous metal oxides-bound (am-MeOx), and crystalline Fe oxides-bound fractions for Sn; Me-Org, residual, am-MeOx, and H_2O_2-Org fractions for Sb; and H_2O_2-Org, am-MeOx, and Me-Org fractions for Bi. Metal migration in the soils was associated mainly with the exchangeable, carbonate-bound, and Me-Org fractions. The capacity of the soils to retain the metals was in the order: Andosol > Fluvisol > Regosol ≅ Cambisol. The mobility of metals was in the order: In ≅ Bi > Sb > Ag ≅ Sn.

Effects of coexisting washing reagents on migration behavior of trichloroethylene in a saturated glass-bead-packed column system

Pollution of soil and groundwater by chlorinated organic solvents such as trichloroethylene (TCE) as a result of transudation accidents has been increasing. Generally, these pollutants are hardly soluble in water, so they tend to be transported slowly in subsurface areas and are not likely to be removed from these areas. To accelerate such transport, injection of water-miscible washing reagents into polluted subsurface areas would be very useful. We therefore conducted a series of efficiency tests of this technique. We checked the vertical migration behavior of TCE by gravity in a series of washing-solution-saturated glass-bead packed columns.

No migration of TCE was observed within 24 h if the water in the column contained no additive or contained dodecylsulfate, dodecanesulfonate, laurate, Tween 20, Tween 60, polyethyleneglycol 1000, polyethyleneglycol 6000, soluble starch, or β-cyclodextrin, because the vacant space in the 0.4-mm ϕ glass beads was too small to migrate. On the other hand, if the solution contained linear dodecylbenzenesulfonate, cetyltrimethylammonium, Triton X-100, Brij35, or Brij58, TCE migrated to the bottom only by gravity. These washing reagents may decrease the resistance force at the vacancy. In the case of the cetyltrimetylammonium or linear dodecylbenzenesulfonate system, migration was observed at all the concentration ranges examined. The migration rate with the former system was much higher, enough to finish the transport within 20 min.

These results indicate that some kind of surfactant may induce transudation of TCE through small cracks from an upper groundwater layer to a lower groundwater layer. It is very important to select a washing reagent and concentration appropriate for each environmental condition.

Characterization of recalcitrant dissolved organic matter in lake water

A steady increase in recalcitrant dissolved organic matter (DOM) has been observed in several lakes in Japan. The accumulation of recalcitrant DOM in lake water will clearly influence the way lakes are managed for environmental protection. It also presents a serious challenge for drinking-water management, because recalcitrant

DOM could be a major precursor of the trihalomethane produced during chlorination in water treatment.

To estimate to what extent sedimentary DOM flux contributes to DOM in lakes, we collected sediment core samples at the center of Lake Kasumigaura monthly from 1997 to 2000, sliced them into several sections, and centrifuged each section to extract its pore water. DOM concentrations in pore water along the sediment depth were measured to determine their vertical profiles. Then the gradient-driven DOM fluxes from the sediment were calculated by fitting the upper portion of the DOM profile with a second-order polynomial and applying Fick's first law.

The benthic DOM flux at the center of the lake was found to vary substantially (Fig. 1). Yearly-averaged fluxes ranged from 0.77 to 2.54 $gC \cdot cm^{-2} \cdot day^{-1}$. Seasonal variations in the DOM flux were significant and distinctively characteristic. The greatest DOM flux was observed almost always in May. In Lake Kasumigaura in spring, the water temperature is not very high—around 18 °C—and there is plenty of dissolved oxygen in the bottom waters above the sediment. It is interesting that the benthic DOM flux was greater in spring than in summer, when the water temperature is higher than 25 °C and the bottom water becomes more anoxic.

How can we conserve coastal marine ecosystems?

The Laboratory of Marine Environment is working with 3 studies on: i) deterioration of the marine environment due to increased nitrogen and phosphorus loadings and silica decline in the aquatic continuum; ii) a mechanism to maintain optimum levels of nutrients in the Ariake Sea, Kyushu; and iii) selection of prioritized marine protected areas (MPAs) in coral reef areas. We give an overview of the third study below.

Biological diversity of corals is maintained by the transport of their eggs and larvae by water flow and by their settlement on shallow water beds after an obligate time (several days). Therefore, it makes sense to select prioritized MPAs as source areas from which the biological particles can most efficiently stay in the shallow areas without being flushed out to the outer sea. For this purpose, we performed a numerical simulation of the flow induced by tides and wind and the trajectories of floating particles in the Sekisei Reef Lagoon, Okinawa, Japan. Nearly half of the particles released from the central part of the lagoon stayed in a region shallower than 10 m. Particles from the outer rim of the lagoon tended to be flushed out rapidly. Therefore, the central part of this lagoon would function as the prioritized MPA.

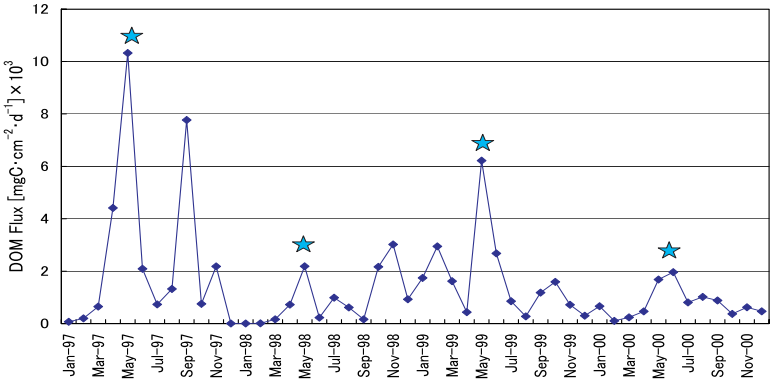
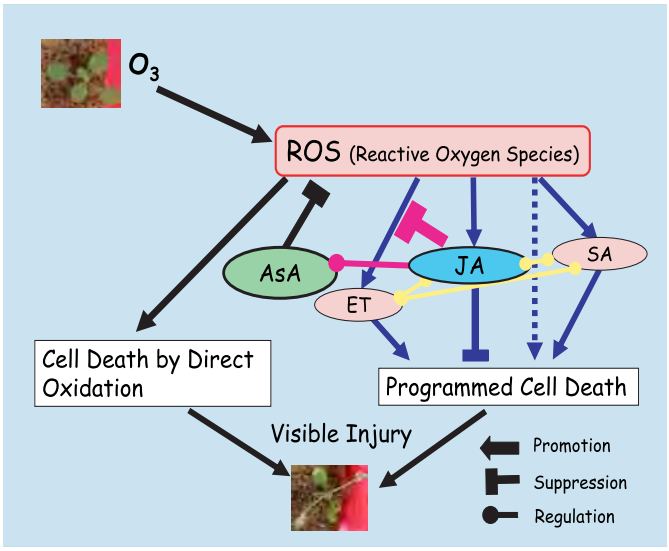


Fig. 1
Benthic dissolved organic matter flux at the center of Lake Kasumigaura.

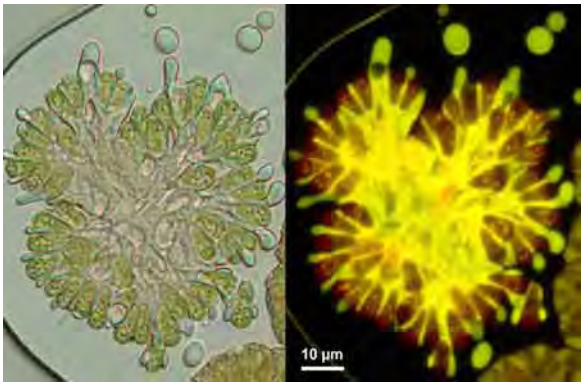
Environmental Biology Division

Canopy walkway for the observation of arboreal animals and plants (under construction in pasoh Forest in the State of Negeri Sembilan, Malaysia).



Molecular respnses to ozone in plant. AsA, ascorbate; ET, ethylene; JA, jasmonates; SA, salicylic acid.

The gate of package catch salmon in the Miomotegawa River.



Micrographs of *Botryococcus braunii*, showing the hydrocarbon (yellow fluourescence) around the cells.

The Environmental Biology Division consists of 4 sections: Ecosystem Function Study, Biodiversity and Phylogenetic Study, Tropical Ecology, and Molecular Ecotoxicology. The Division performs basic and applied research on the effects of various environmental stresses, both chemical and physical, on organisms at various levels, from molecules and cells to individuals, species, populations, and ecosystems. The Division's work is also directed toward the conservation of genetic biodiversity, species, and ecosystems. In 2004, the Division performed 14 studies funded by NIES, 4 studies supported by the Global Environmental Research Fund (Ministry of the Environment), 5 studies funded by the Ministry of Education, Culture, Sports, Science and Technology, and 3 studies funded by other ministries.

Ecosystem Function Study Section

Stable isotope ratio of salmon families in and fish feed of stock salmon Miomotegawa River, Japan

We examined the stable isotope ratios of a number of salmon families and the feed given to stock salmon (Fig. 1). The $\delta^{13}C$ of young wild salmon (*Oncorhynchus keta*) was –21.00‰ ± 1.35‰, and the $\delta^{15}N$ was 13‰ ± 0.37‰. The $\delta^{13}C$ of young stock salmon was –16.44‰ ± 0.38‰, and the $\delta^{15}N$ was 13.39‰ ± 0.27‰. Therefore, young wild salmon and young stock salmon can be differentiated by their difference in $\delta^{13}C$ value. The $\delta^{13}C$ of fish feed in 2003 was –17.84‰ ± 0.19‰ and the $\delta^{15}N$ was 8.98‰ ± 0.11‰. The value of $\delta^{15}N$ in young stock salmon was 4.4‰ higher than in their feed. The $\delta^{15}N$ of wild masu trout (*Oncorhynchus masou*) increased from upstream to downstream. The $\delta^{15}N$ of wild charr (*Salvelinus leucomaenis pluvius*) upstream was almost the same as that of wild masu trout upstream. There were no differences between the $\delta^{13}C$ values of wild masu trout and wild charr. Therefore, because these salmon families feed on the same aquatic insects their $\delta^{13}C$ values were similar. The $\delta^{15}N$ values of wild charr and masu trout in the same area were almost the same, depending on the natural abundance of nitrogen in the form of aquatic insects.

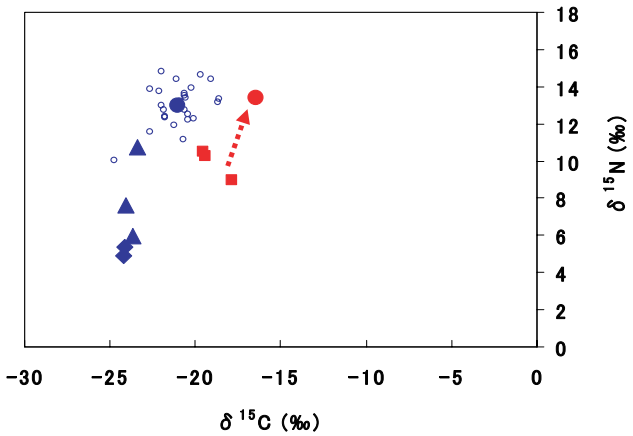


Fig. 1
Average of stable isotope ratio of salmon families and fish feed of stock salmon.
●: young wild salmon *(Oncorhynchus keta)*
●: young stock salmon *(Oncorhynchus keta)*
▲: wild masu trout *(Oncorhynchus masou)*
◆: wild charr *(Salvelinus leucomaenis pluvius)*
■: fish feed

Biodiversity and Phylogenetic Study Section

We conducted fundamental research on the diversity of microorganisms and benthic animals, as follows,

1) To elucidate the processes contributing to the intercontinental introduction of harmful marine phytoplankton, we monitored the biodiversity and succession of the microorganisms in ships' ballast tanks (Fig. 2).

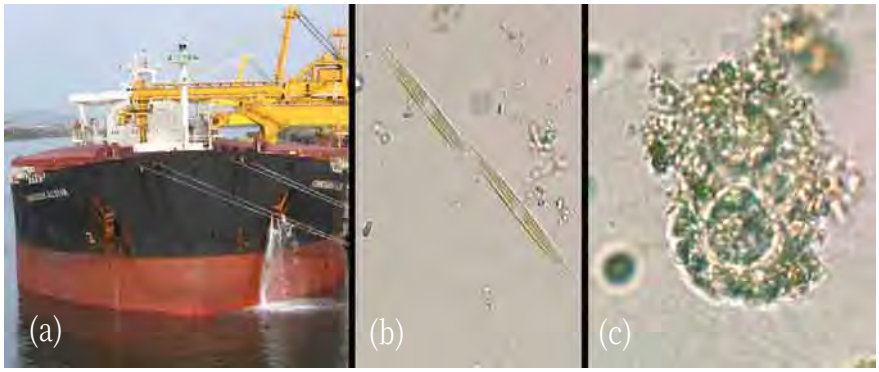


Fig. 2
A bulk carrier used for our monitoring research and light micrographs of microorganisms collected from the ballast tank.
(a) A bulk carrier.
(b) Actively moving *pseudo- nitzschia* sp. The concentrations of cells stayed above a certain level, although cell counts generally decreased during the time ships were at sea
(c) Heliozoan species showed a active growth until reballasting, suggesting their high level of resistance.

2) We targeted the hydrocarbon-producing green alga *Botryococcus braunii* to of developing renewable fuel sources, and we established 73 strains. After we had characterized the strains in terms of morphology, phylogeny, hydrocarbon type, and growth, we selected 5 strains with high growth rates and differences in other features for further experiments.
3) To analyze the effects of environmental stresses on algae, we focused on accumulation of UV-absorbing compounds (mycosporine-like amino acids; MAAs), and surveyed the MAAs in various green and blue-green microalgae maintained in the NIES collection.
4) We investigated the genetic diversity of a lichen, *Parmotrema tinctorum*, to analyze the state of air pollution in the city of Shizuoka. Although mycobiont diversity showed no clear correlation with air pollution, photobiont diversity seemed to be poor in NOx-polluted areas and rich in unpolluted areas.
5) To reveal the physiological diversity of cellulose-decomposing bacteria, we determined the C-source utilization patterns of isolates from the peat soils from mires in Japan. The C-source utilization pattern was affected by the types of C-sources available in the habitat.

Tropical Ecology Section

1) Ecosystem management in the tropics
With the aim of providing a new tool for the ecological assessment of the current degradation status of forests and for forecasting future environmental threats to forests from landscape changes, we conducted the following studies in a pilot study area of Peninsular Malaysia. First, we gathered available information on ecosystem services-(e.g. biodiversity, watershed ecosystems, soil and nutrient) and established an ecosystem database. The ultimate goal of the project was to determine the best way of optimizing ecosystem service values and goods, and to give policy makers and local people better answers or guidelines for formulating landscape management plans. Toward this goal, we then developed a risk assessment tool that can provide baseline information of ecosystem services and enables the cost benefit analysis. Finally, to deepen our understanding of the problems faced by local communities in relation to deforestation, we studied the relationship between forest conservation systems and the aboriginal peoples of Peninsular Malaysia. Our results suggest that there is less usage of or dependence upon the forest by the local people; hence, forest degradation may proceed with greater facility.

2) Carbon dynamics and global warming monitoring in grasslands on the Qinghai-Tibetan Plateau

We are examining CO_2, fluxes in grasslands on the Tibetan Plateau. Major research activities include (1) estimation of the carbon budget of these alpine grassland ecosystems; (2) study of the ecological and biological mechanisms underlying the carbon cycle in alpine ecosystems; and (3) assessment of the possible impacts of global warming on greenhouse gas emission from the grassland ecosystems. Our study shows that the alpine grasslands currently hold a significant stock of carbon and have a large potential to absorb CO_2 from the atmosphere. In 2005, we launched a long-term monitoring project on global warming and its effects on alpine ecosystems. Focusing on the world's highest plateau, we have set a vertical transect, starting from 4300 m to 5500 m above sea level, to monitor physical and biological indicators of global warming.

Molecular Ecotoxicology Section

The Molecular Ecotoxicology Section aims to elucidate the effects of environmental stressors, such as air pollutants and ultraviolet light, on plants, and the mechanisms of plant tolerance to conditions of stress. We are focusing on the genes involved in these protection mechanisms and are conducting molecular biological studies with various stress-related mutants of *Arabidopsis thaliana*.

Jasmonates, composed of jasmonic acid (JA) and methyl jasmonate (MeJA), are widely distributed signaling compounds in plants. Using an ozone-sensitive *Arabidopsis* mutant, *oji1*, which shows increased ozone-induced ethylene production and reduced sensitivity to MeJA, we previously showed that jasmonate-mediated signaling suppresses ozone-induced ethylene biosynthesis as well as cellular injury. Recently, we found that ascorbate contents increased in *Arabidopsis* upon ozone exposure, in spite of foliar injury. By 6 h after the beginning of ozone exposure, although *oji1* plants had lower ascorbate levels than did wild-type plants, exogenous MeJA had suppressed the increase in ascorbate content only in the wild-type plants (Fig. 3). These results imply that jasmonate-mediated signaling is involved in the regulation of ascorbate, an important defense biomaterial, in the surviving cells under stress caused by ozone (shown in the Figure at the front of this chapter).

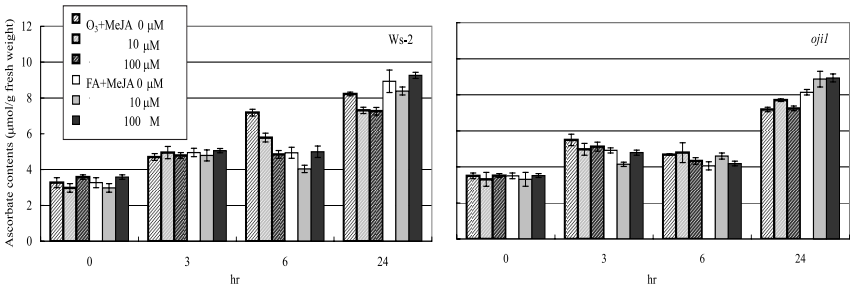


Fig. 3
Ascorbate contents in MeJA-pretreated *Arabidopsis* during exposure to 0.2 ppm ozone with or without methyl jasmonate (MeJA). Vertical bars show standard errors. n = 3 for each value. FA, fresh air. Ws-2, wild-type plant; *oji1*, ozone-sensitive mutant.

Environmental Information Center

The Environmental Information Center provides various kinds of environmental information for public through web sites.

The Environmental Information Center (1) provides information technology support for research and related activities at NIES, and (2) carries out public relations activities for NIES, including publication of NIES reports. In addition to these activities, the Center (3) performs various other activities, such as collecting and processing various kinds of environmental information and disseminating it to the general public, and performing tasks commissioned by the Ministry of the Environment. To implement these tasks more efficiently, the Center was reorganized in April 2003.

1. Information technology support for research and related activities at NIES

The activities of the Center in this field comprise: (a) management and operation of the computers and related systems at NIES; (b) improvement of work efficiency of NIES using information technology; and (c) running a library service.

a. Management and operation of computers and related systems

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

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

b. Improvement of work efficiency using information technology

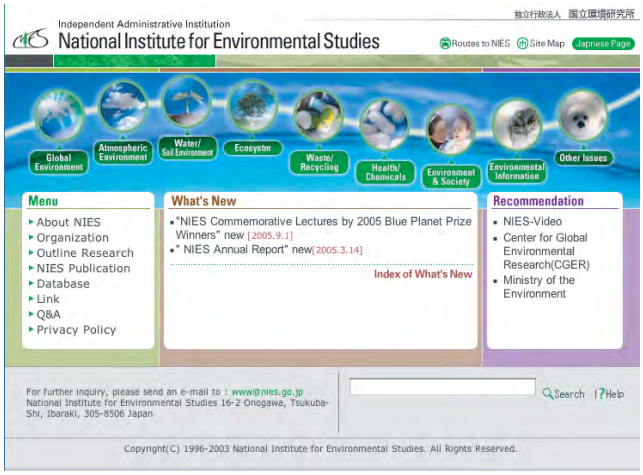
The Center gives information technology support to the management sector of NIES, with the aim of increasing work efficiency. The Center also provides NIES researchers with relevant processed research data and helps them to disseminate their research data through the NIES homepage. In fiscal year 2004, the Center supported the following activities:

- construction of the research project database
- preparation of an automatic typesetting system, using XML, for issuing the NIES research program
- construction of a database of basic individual information about each member of staff at the Institute
- construction of a database of visitors
- construction of a document management system for information disclosure
- collection of a database of external inquiries
- preparation for the Intranet system to be managed by the General Affairs Division
- support for enforcement of government legislation to protect the privacy of information at the Institute
- processing of various research data to be provided through the NIES website.

c. Library service

As of March 2005, the NIES library held 48,685 books, 462 technical and scientific serials, 9,688 maps, 117,719 microfiches, and various other reports and reference materials.

In addition to these materials, researchers at NIES can access documentary information through commercial databases such as Web of Science, Science Direct, MEDLINE, JOIS, STN-International, G-Search, and the British Library inside web.
Library facilities include separate reading rooms for books, journals, indexes and abstracts, reports, maps, and microfiche.



2. NIES public relations activities, including publication of NIES reports

The activities of the Center in this field comprise (a) management of the NIES World Wide Web (WWW) Internet site and (b) editing and publication of NIES reports such as research reports and this Annual Report.

a. Management of NIES WWW

NIES began to provide public information on its research activities and results via the Internet (http://www.nies.go.jp/) in March 1996. The website was completely renewed and improved in accordance with the restructuring of NIES in April 2001 with a new status as an independent administrative institution. The design of our website was changed in April 2003 to improve accessibility to necessary information.

b. Editing and publication of NIES reports

Reports of NIES research activities and results, such as the NIES Annual Report and research reports, official newsletters (“NIES News”, in Japanese), and NIES research booklets (“Kankyo-gi”, in Japanese) are edited, published and distributed by the Center.

3. Other activities

In addition to the activities mentioned above, the Center (a) collects, processes, and disseminates environmental information for the general public, (b) conducts tasks commissioned by the Ministry of the Environment, and (c) acts as the national focal point of UNEP-Infoterra (see 3c below).

a. Collection, processing, and dissemination of environmental information

NIES is required to carry out “the collection, processing, and dissemination of environmental information” as one of its major tasks. The Center (a-1) provides various kinds of environmental information to the public through websites, (a-2) processes and manages environmental information databases, and (a-3) provides environmental information using GIS (geographic information systems).

(a-1) EIC Net and Environmental Technology Information Network

The “EIC Net” (Environmental Information and Communication Network, http://www.eic.or.jp/) provides various kinds of environmental information, such as news

and topics on the environment, a chronology of environmental issues in Japan, and environmental education and training for children. In fiscal year 2004 we added the content of links on the website of the environment of the school, and we also added Japanese–English translations to our original collection of environmental terms. We updated our environmental information quiz and added to the functionality of the WEB accessibility tool.

Furthermore, the Center opened the Environmental Technology Information Network (http://e-tech.eic.or.jp/) in August 2003. It contains pages of environmental technology news on ministries and companies; research reports and review papers by environmental specialists; and seminar and event information on environmental technology. In fiscal year 2004, we improved the homepage of the Environmental Technology Information Network and added more menus for easier operation.

At present, these sites are available only in Japanese.

(a-2) Processing and management of environmental information databases
Various environmental data are needed for research, policy decisions, and policy enforcement. The Center compiles and processes air quality and water quality data as monitored by local governments and reported to the Ministry of the Environment. These processed data can be accessed through the database on the NIES WWW, and duplication and lending services are also available.

(a-3) Provision of environmental information using GIS
The Center, with the cooperation of the Ministry of the Environment, has been developing an environmental data provision system using a GIS. This system helps users to easily understand the status of the environment by showing data on environmental quality together with other information on maps. The system has been publicly available through the Internet since September 2002.

b. Tasks commissioned by the Ministry of the Environment
The Center performed the following 6 tasks commissioned by the Ministry of the Environment in fiscal year 2004.

(b-1) Development of an information system on total management of the aquatic environment
The purposes of the system are to help a wide range of people to understand the current state of Japan's aquatic environment and to support conservation activities and scientific investigations by providing relevant data and information through the Internet.
Recently, in the final fiscal year of the 4-year development project, the Center created a web page based on the results of the previous 3 years. Overall information on various water quality environments is presented on this page .

(b-2) Management of display systems for wide-area air pollutant surveillance
In this fiscal year, the Center operated and managed the air pollution real-time

monitoring system, which collects air pollution data from monitoring stations every hour and displays the levels of air pollution and the status of photochemical oxidant warnings and alarm issuance on a map.

In addition, the Center updated the pollen observation system as part of the above system. The pollen-scattering situation in the Kanto, Chubu, and Kansai regions can be observed on the website during the pollen-scattering period.

(b-3) Development of an information management system for noise, vibration, and offensive odor

This fiscal year, the Center developed a system for data output and a user management system for local government. Moreover, the Center developed the registration of and updated the data on "100 Japanese Sites with Good Fragrance" and "100 Japanese Soundscapes".

Furthermore, the Center performed the basic design of a star-watching network.

(b-4) Analysis of the results of a national survey of aquatic animals

This fiscal year, the Center totaled, analyzed, and evaluated the results of a national survey of aquatic life in 2004 with a support information system developed last year, and submitted a survey report to the Ministry of the Environment.

In addition, the Center improved the website of the national survey of aquatic life, and added a page on the survey results.

(b-5) Examination of methods of expression of traffic noise survey data by GIS

This fiscal year, the Center set up a server for a traffic noise survey and established a website as one of the subsystems of environmental GIS. The Center observed access to the website and examined the efficiency of operation by users.

We also produced leaflets introducing the website.

(b-6) Development of a GIS to publicly release the results of dioxin measurements

This task started recently, and the Center has developed the system as one of the subsystems of environment GIS. With this system, measurement locations can be displayed on the maps. When a user clicks on a location, the measurement result for that location is displayed in a table. The result can also be displayed in a graph and can be downloaded.

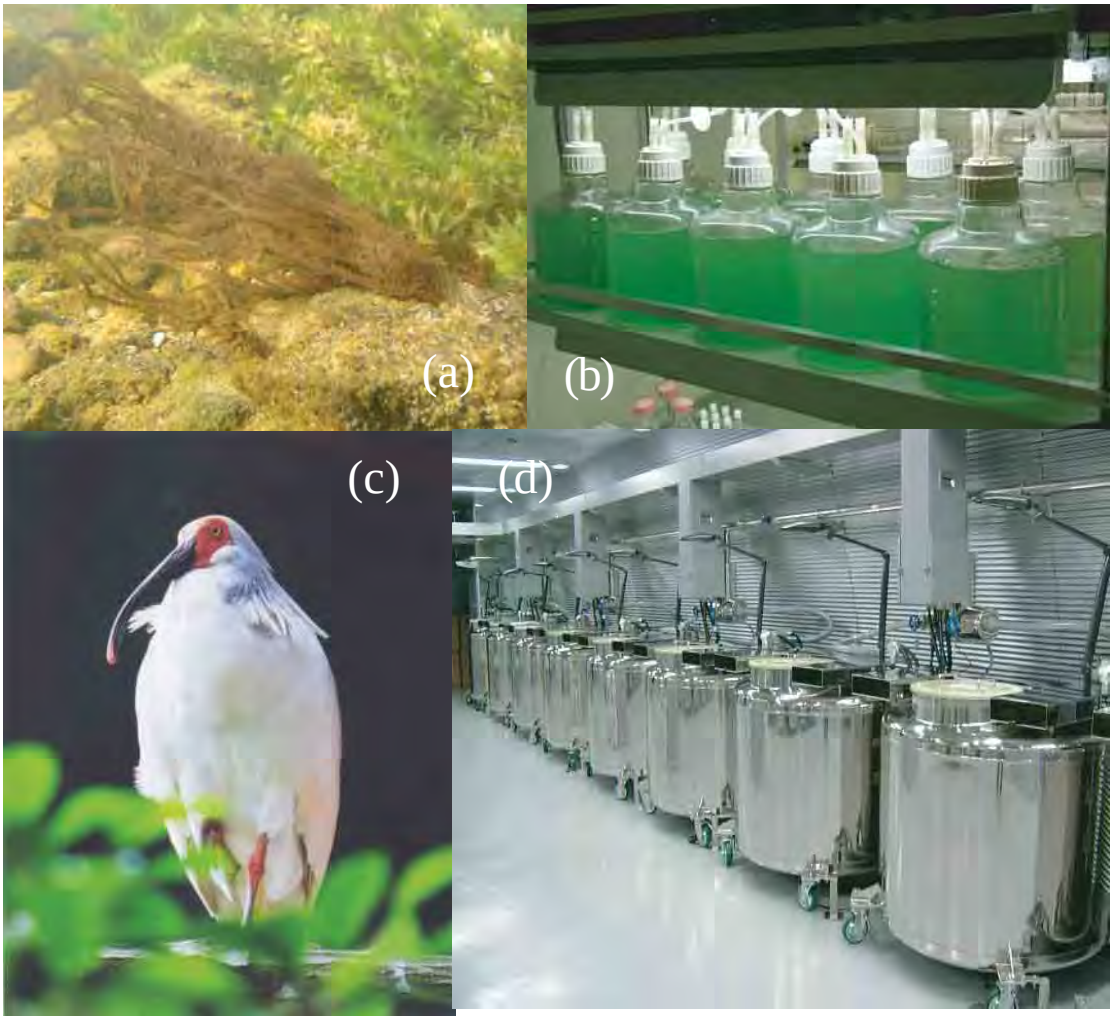
The dioxin measurement results after the 1997 fiscal year are used.

c. National focal point of UNEP-Infoterra

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

This fiscal year, one of our staff participated in the international meeting held by UNEP from 13 to 16 April in Geneva, and discussed with other delegates plans for future activities.

Laboratory of Intellectual Fundamentals for Environmental Studies



(a):The red alga *Thorea okadae*, one of endangered species in Japan.
(b):Culturing of cyanobacterium *Microcystis aeruginosa* (Water bloom) for NIES Certified Reference Material No.26.
(c):The extinct Japanese crested ibis *Nipponia nippon* (Provided by Sado Japanese Crested Ibis Comservation Center).
(d):Low - temperature tanks for storage in liquid nitrogen.

The Laboratory of Intellectual Fundamentals for Environmental Studies (LIFES) consists of 2 research sections: the Environmental Analytical Chemistry Section and the Biological Resources and Informatics Section. They are responsible for organizing all of the intellectual research fundamentals accumulated since NIES began, and for developing basic research techniques that will be needed in the future. These fundamentals and techniques are used for effective implementation of research and to form research networks.

LIFES functions as a reference laboratory for environmental research in Japan through: 1) improving methods of ensuring analytical quality control and cross-checking of analytical techniques, and 2) improving methods of classifying and culturing microalgae and other laboratory organisms, and preserving and supplying those organisms to provide standards for classification, standard strains for bioassay tests, and strains with special functions.

Preparation of environmental Certified Reference Materials

Environmental Certified Reference Materials (CRMs) are utilized for evaluation of new analytical methods and for accuracy control of pretreatment and instrumental analyses. NIES has been preparing and distributing environmental and biological CRMs since 1980. Over 120 CRMs were distributed to researchers worldwide this fiscal year. We completed the preparation of a new CRM, No. 26, from toxic water bloom-forming cyanobacterium, *Microcystis aeruginosa*, cultured under incubation at 20 ˚C (Fig. 1).

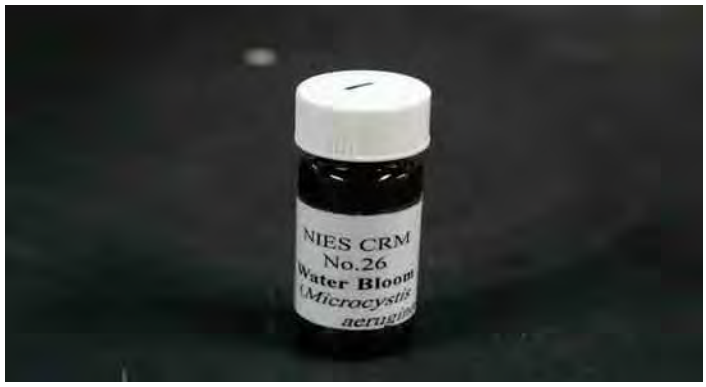


Fig. 1
New certified reference material for toxic water bloom of *Microcystis aeruginosa* (*cyanobacterium*) has been produced as NIES Certified Reference Material No. 26.

Long-term storage of environmental samples (environmental specimen bank)

We continued to collect and prepare environmental samples for long-term, low-temperature storage as part of our expanded program to make samples available for retrospective analysis of pollutants. The environmental specimen time capsule facility is capable of accommodating various items of equipment for the low-temperature preparation of environmental specimens for long-term storage; such specimens can be stored for 50 years under an atmosphere of liquid nitrogen vapor at about –150 °C. We stored 200 more samples this year, bringing the total number of time-capsule samples to about 580 (Fig. 2).

Fig. 2
Environmental samples cryopreserved with liquid nitrogen.

Fundamental studies of germline stem cells using biotechnology

With the aim of developing new technologies in the field of bioscience, we are studying germline stem cells (primordial germ cells) in the Amniota (mainly in the Aves). We have made germline chimeras by transplantation of primordial germ cells, and have obtained offspring originating from these introduced cells by using backcross analysis. We are now trying to put this method to practical use for the proliferation of threatened bird species. Our techniques should be useful in cleaning up vertical infections via eggs and also in the recovery of populations from inbreeding depression by transplantation of primordial germ cells in the early embryonic stages (Fig. 3).

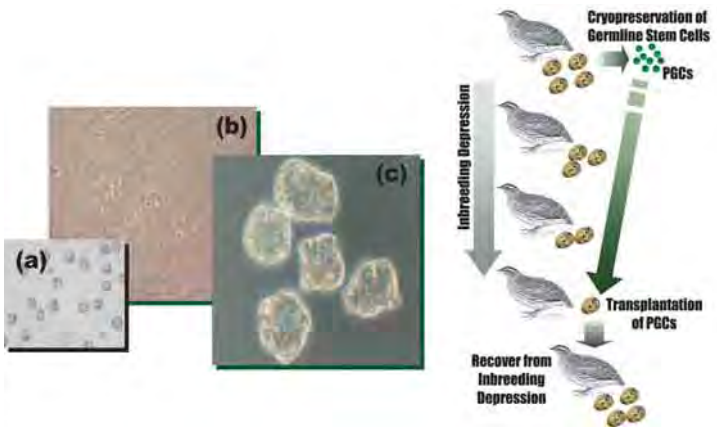


Fig. 3
Left: *In vitro* long-term culture of chick primordial germ cells (PGCs):
(a): Isolated PGCs.
(b): Initial phase of PGC culture on feeder cells.
(c): Proliferated PGC colonies after 2 weeks' incubation.
Right: Use of frozen germline cells
Populations could be rescued from inbreeding depression by transplantation of stored primordial germ cells originating from younger generations.

Preservation of cells and gene resources of threatened wildlife species

(1) Threatened wild animals

In the hope of being able to make future contributions to the conservation of threatened wild animals, we cryopreserve their cells (including germline cells) and their tissues for genetic analysis, with the support of the National Time Capsule Program for the Environment and Threatened Wildlife. As of March 2005 we had cryopreserved samples of 333 lines (tissues, cultured cells, and sperm), including those from the Tsushima leopard cat (*Felis bengalensis euptilura*), Hondo stoat (*Mustela erminea nippon*), Kuril habor seal (*Phoca vitulina*), Steller's sea lion (Eumetopias jubatus), Asian particolored bat (*Vespertilio superans*), Ryukyu flying fox (*Pteropus dasymallus daitoensis*), Japanese crested ibis (*Nipponia nippon*) (Fig. 4), eagle owl (*Bubo bubo*), white-tailed eagle (*Haliaeetus albicilla albicilla*), Hodgson's hawk-eagle (*Spizaetus nipalensis orientalis*), Okinawa rail (*Gallirallus okinawae*), Steller's sea eagle (*Haliaeetus pelagicus pelagicus*), goshawk (*Accipiter gentiles fujiyamae*), ptarmigan (*Lagopus mutus japonicus*), Ancient Murrelet (*Synthliboramphus antiquus*), Japanese night heron (*Gorsakius goisagi*), Japanese wood pigeon (*Columba janthina*), crested serpent eagle (*Spilornis cheela*), spoonbill (*Platalea leucorodia*), Pryer's woodpecker (Sapheopipo noguchii), Ryukyu ayu-fish (*Plecoglossus altivelis ryukyuensis*), deep-bodied bitterling (*Acheilognathus longipinnis*), Sakhalin taimen (*Hucho perryi*), Ogasawara-Yoshinobori goby (*Rhinogobius* sp.), metropolitan bitterling (*Tanakia tanago*), striped bitterling (*Acheilognathus cyanostigma*), and spot-ear brook perch (*Coreoperca kawamebari*).

Fig. 4
The extinct Japanese crested ibis *Nipponia nippon* (Provided by Sado Japanese Crested Ibis Comservation Center).

(2) Threatened algae

We have been surveying the status of threatened algal species in Japan since 1995. In the course of these surveys, we collect and culture strains of threatened algal species in our Biological Resource Collections. We now maintain 23 species and 77 strains of charophytes and 11 species and 126 strains of freshwater red algae in culture (Fig. 5).

Fig. 5
Unialgal cultures of threatened species of charophytes.

Investigation, collection, and storage of microbes useful for environmental conservation and development of laboratory organisms

At the Microbial Culture Collection (MCC), we: 1) accepted 231 microalgal strains deposited by scientists within or outside NIES after evaluation by the Committee for Evaluating Microbial Culture Strains; 2)made frozen samples of 138 strains of cyanobacteria, which are now entirely preserved in liquid nitrogen (we now have a total of 428 frozen strains); 3) distributed 983 algal strains to researchers and engineers; and 4) renewed the MCC database system and updated our homepage (Fig. 6). We now maintain a total of more than 1800 strains. These activities are conducted in collaboration with 5 institutions as part of the National Bio-Resources Project.

Fig. 6
The Microbial Culture Collection – NIES homepage at http://www.nies.go.jp/biology/mcc/home.htm

Development of a biodiversity information infrastructure for a wide range of bioresources

To meet the goal of the Global Taxonomy Initiative (GTI) under the Convention on Biological Diversity, we have developed a GTI website (Fig. 7). The GTI Japan node of the Global Biodiversity Information Facility (GBIF) provides specimens and observation information on biodiversity in Japan and the Asia region. The Bacteriology Insight Orienting System (BIOS) provides authenticated scientific names for bacteria and archaea; it can be accessed via the GBIF taxonomy browser.

Fig. 7
The Global Taxonomy Initiative Japan homepage at www.gti.nies.go.jp/

Management and operation of key analytical equipment

The laboratory has been working to improve the sensitivity and accuracy of analysis of environmental specimens at NIES and has been managing and operating commonly used key analytical equipment. An on-demand analysis service has been established and is operated by personnel technically trained in the use of 10 instruments. GC-MS (Fig. 8) and NMR equipments were renewed this spring. We received requests for analyses on about 30 research themes from 50 researchers, whom we provided with useful data derived under a high level of quality control.

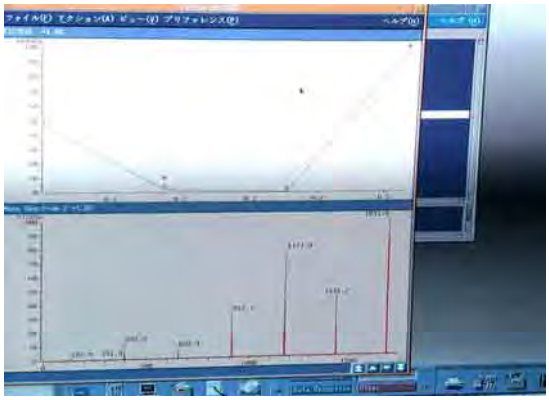
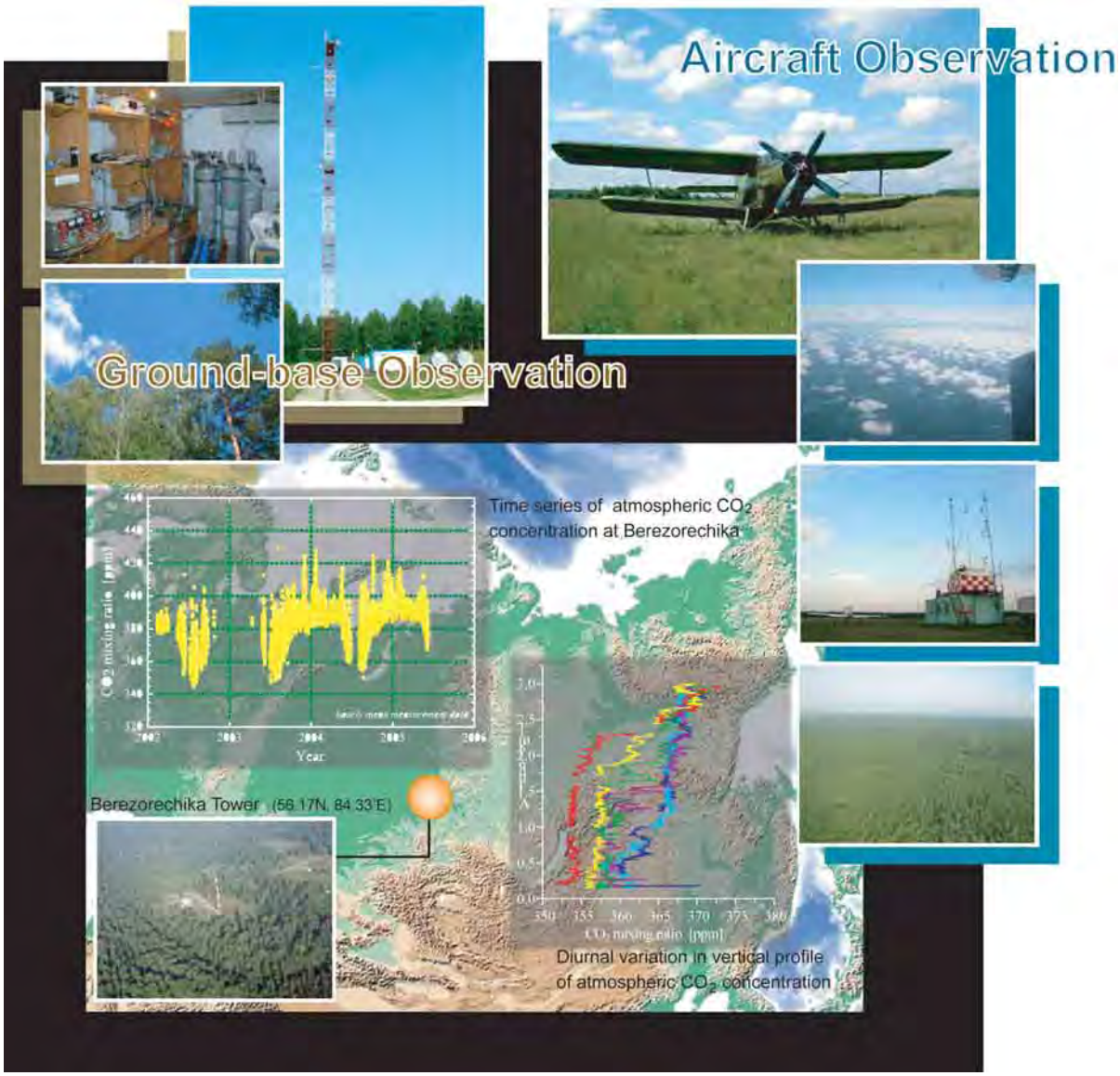


Fig. 8
A new GC-MS instrument was purchased for various research projects on recent environmental problems. The sample graph shows some linked scan data (pseudo MS-MS mode) on the Fast Atom Bombardment ionization of CsI.

Center for Global Environmental Research



Developement of Greenhouse Gases Monitoring Network in Siberia

The Center for Global Environmental Research (CGER) was established in 1990 to promote and support global environmental research from both national and international viewpoints, with the aim of reducing the uncertainties of future prediction. CGER has 3 missions: monitoring of the global environment, support for global environmental research, and synthesis of global environmental studies.

1. Monitoring of the Global Environment

Long-term monitoring of greenhouse gases and other air pollutants

Greenhouse gases (GHGs) (e.g., CO_2, CH_4, and N_2O) are monitored by using several platforms to improve our understanding of their global atmospheric behaviors. We have 2 remote stations: Hateruma Island, over 1000 km southwest of the Japanese mainland, and Cape Ochi-ishi, in northeastern Hokkaido. Also, airplanes flying over Siberia and commercial ships that operate in the Pacific are used to measure GHGs and collect air samples.

At the 2 monitoring stations, continuous monitoring of GHGs is performed together with measurement of related species (e.g., CO, ozone, NOx, and SOx), with the aim of furthering our understanding of global warming and atmospheric transport processes. Most species are measured automatically and the data are transferred to NIES at Tsukuba by dedicated network lines . Bottle samplings are also performed to measure some species, such as halocarbons, oxygen, and isotopes. Over the last 10 years, the average CO_2 concentration measured at both stations has increased from about 360 ppm to 380 ppm a growth rate of about 2 ppm/y. This rate of increase is higher than that of the 1980s. The growth rate fluctuates each year with the climatic conditions. In particular, the occurrences of El Niño/Southern Oscillation (ENSO) events seem to significantly affect the growth rate. A large seasonal variation in CO_2 concentration due to photosynthesis by terrestrial plants was observed at both sites, whereas the daily variation was rather small. N_2O concentrations at both stations increased continuously between 1996 and 2004, but CH_4 concentrations have increased only very slightly over the last 7 years.

In the Pacific, 2 ships, *Fujitrans World* (Kagoshima Senpaku) and *Pyxis* (Toyofuji), were used to collect air samples along shipping routes between Japan and Australia and between Japan and the USA. For sampling at latitudes higher than 40˚N, another ship route (*skaubryn*) was started with the kind cooperation of Seaboard Int. Shipping Co. . Latitudinal distributions and long-term trends of GHGs were observed, together with trends in oxygen and isotope levels.

In Siberia, the vertical distribution of CO_2 was measured over 3 sites every month. A larger seasonal variation in CO_2 concentration was observed at lower altitudes. Forests in Siberia seem to play important roles as sinks of CO_2 from the atmosphere, but Siberian wetlands appear to constitute large sources of CH_4.

Integrated carbon dioxide flux monitoring. Carbon exchange between the atmosphere and the terrestrial ecosystem, especially in larch forests, which are widely

distributed throughout Asia, is monitored at two remote stations, the Tomakomai Flux Research Site at Tomakomai (since 1999) and the Teshio CC-LaG (Carbon Cycle and Larch Growth experiment) Site in Horonobe (since 2001). To gain a better understanding of the mechanisms behind the CO_2 balance, we are making integrated observations using not only basic micrometeorological methods, but also physioecological methods. Unfortunately, the Tomakomai Flux Research Site was badly damaged by a typhoon on 18 September 2004. We are now discussing the use of an alternative site for continuation of our observations.
Moreover, to evaluate the spatial carbon balance from point data, we are developing a new remote-sensing technique for the quantitative detection of photosynthetic activity and biomass change.

We developed a tree height measurement method that uses an airborne laser survey. The study area was a larch forest at the Tomakomai Flux Research Site. The laser survey data were collected in 1999, 2001, and 2003. The height of each tree was calculated by laser pulse analysis. By using the relationship between tree height and stem volume we then determined the stem volumes of the trees. Our results for the average increase in height of the forest stand (0.23~0.25 $cm \cdot y^{-1}$) and for average increase in forest stand volume (11 $m^3 \cdot y^{-1}$) were both close to the data obtained by field survey or observation of CO_2 flux; therefore, this method is accurate enough for use in measuring biomass growth.

Monitoring of stratospheric ozone. Vertical profiles of ozone are monitored at Tsukuba (lat 36˚02´N, long 140˚07´E) and at Rikubetsu in Hokkaido (lat 43˚30´N, long 142˚42´E) with millimeter-wave radiometers by measuring the emission spectra of ozone at 110.836 GHz. These radiometers are equipped with supercooled superconductor-insulator-superconductor (SIS) mixers, local oscillators, intermediate frequency processors, and acousto-optical spectrometers (AOS). At Tsukuba, the bandwidth of the instrument was originally 60 MHz with 40 kHz frequency resolution, allowing measurement of the vertical profiles of ozone at altitudes from 38 to 76 km. The variations in the ozone profile obtained at the Rikubetsu station were analyzed and correlated with variations in the synoptic-scale meteorological system.
In addition, we are organizing a voluntary network to monitor harmful UV radiation (UV-B) on a national scale and to evaluate the adverse effects of UV-B on human health.

Monitoring of the atmospheric environment from space. The Improved Limb Atmospheric Spectrometer II (ILAS-II) aboard the Advanced Earth Observing Satellite II observed the high latitudinal ozone layer from April to October 2003. The ILAS-II data-handling facility (DHF), which is under the management of CGER, has been used to process, reprocess, store, and distribute the ILAS-II data. The distribution of Version 1.4x ILAS-II data products from the DHF to registered ILAS-II researchers began in March 2004. The computer system of the ILAS-II DHF was replaced with a more compact one at the end of March 2005. In order to proceed with the next satellite project of NIES, a new Greenhouse gases Observing Satellite (GOSAT) research

team was organized in April 2004 under the director of CGER. GOSAT, which will be launched in 2008, is planned to observe atmospheric CO_2 and CH_4 from space. The GOSAT research team promotes research on the development of data retrieval algorithms for CO_2 and CH_4 column density, experimental airborne and in situ measurements, and model studies of carbon source and sink estimations (Fig. 1).

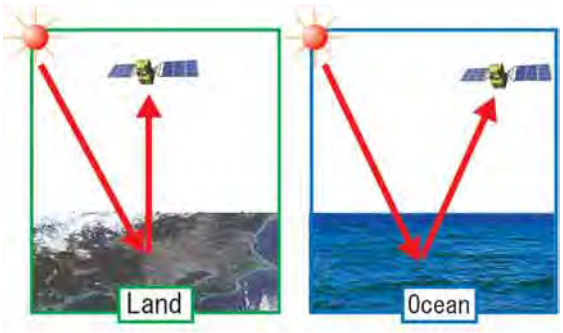


Fig. 1
GOSAT measurement geometry.

Water quality monitoring—GEMS/Water. CGER is participating in the Global Environmental Monitoring System Freshwater Quality Program (GEMS/Water), organized by UNEP and WHO for the collection and integration of monitoring data on terrestrial water bodies. Since 1994, monitoring data on river and lake water at 21 stations have been compiled.

• **Lake Mashu baseline monitoring:** Lake Mashu, in eastern Hokkaido, is one of the clearest lakes in the world. Since 1980, the water of Lake Mashu, as a representative of lakes least affected by pollution sources, has been sampled in late summer, when thermal stratification develops. Extremely precise analyses are performed on the samples, which are taken from the surface to the deepest point (212 m).
• **Lake Kasumigaura trend monitoring:** Since 1976, we have been conducting continuous field studies every month at Lake Kasumigaura, northeast of Tokyo, a representative Japanese eutrophic lake.

2. Support for Global Environmental Research
Establishment of standard gases: We have developed a standard gas system for baseline monitoring of greenhouse gases (e.g., CO_2, CH_4, N_2O, and O_3) and other gases (e.g., NO, CO, and H_2). We have been studying the ozone scale by comparing the results obtained using a standard reference photometer (NIST) and a gas phase titration method. CGER also participated in several international inter-comparison activities, such as round-robin tests by the National Oceanic and Atmospheric Administration (NOAA)/ World Meteorological Group (WMO), a Trace Atmospheric Carbon Monoxide Sensor (TACOS) inter-comparison in the EU, and an inter-comparison with the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Australia.

Global environment databases. CGER is creating original databases for researchers, policymakers, and members of the public to improve our understanding of global environmental issues such as climate change and ecosystems. Most of the database project is linked with the research activities at NIES. Databases are either created to support global-level modeling studies or created from the results of research activities. Some of the databases are used directly and play very important roles in international environmental assessments, such as those performed by the Intergovernmental Panel on Climate Change (IPCC). Current database projects include: 1) a greenhouse gas emission scenario database (IPCC); 2) an emission inventory of air pollutants in Asia (Asia-Pacific Integrated Model); 3) material flows based on LCA analysis; 4) a terrestrial ecosystem database for the tropics; and 5) post-Kyoto terrestrial carbon sink issues.

Greenhouse Gas Inventory Office of Japan. The Greenhouse Gas Inventory Office (GIO) of Japan was established in 2002. GIO's primary mission is to prepare and develop national GHG inventories in accordance with the United Nations Framework Convention on Climate Change (UNFCCC). GIO has been integrating diverse information relevant to GHG inventories and providing it to the public to promote GHG mitigation strategies and measures against global warming. GIO's other activities are to conduct trend analyses of GHG inventories (Fig. 2); to perform various tasks relevant to GHG inventories; to conduct workshops and research activities to encourage countries in the Asia region to enhance their capacities for developing their own GHG inventories; and to contribute to the work of international environmental organizations such as UNFCCC and the IPCC by hosting international conferences or seminars related to GHG inventories.

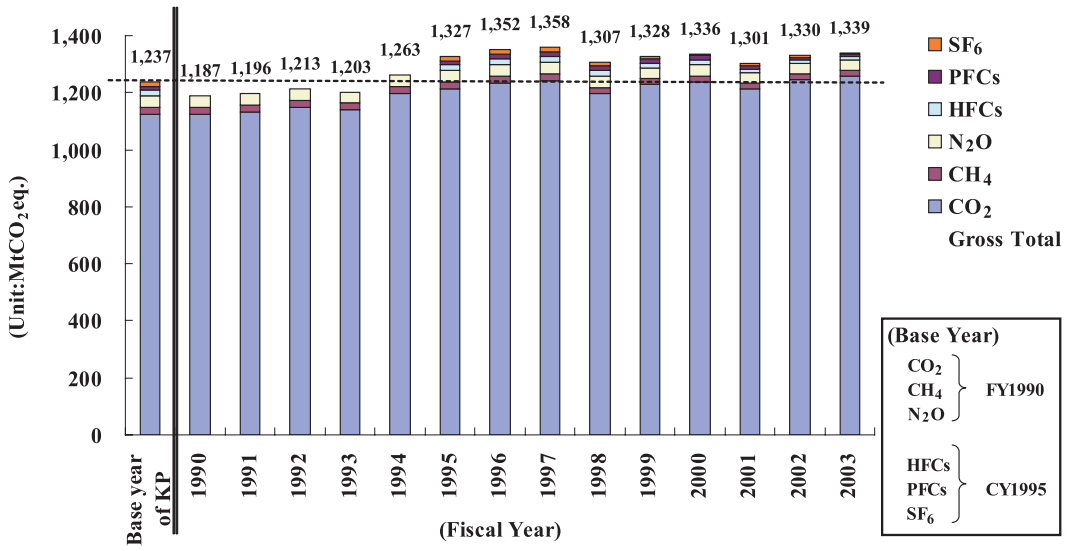


Fig. 2
Trends in emissions of greenhouse gases in Japan.

Coordinating supercomputer-aided research programs

To predict climate change on a 100-year time scale, several groups of scientists around the world have conducted model calculation experiments based on emission scenarios proposed by the socioeconomic research group. A new supercomputer system, an NEC SX-6/64-M8 (64 CPU = 8 CPU/nodes, 512 GFLOPS, 512 GB memory) was operated at its full capability in FY2004. -CGER published two annual in 2004: the CGER'S SUPERCOMPUTER ACTIVITY REPORT, Vol.12-2003, and the, CGER'S SUPERCOMPUTER MONOGRAPH REPORT Vol. 10.

3. Synthesis of Global Environmental Studies

International Research Cooperation—AsiaFlux. The AsiaFlux network was established in 1999 to promote cooperation and exchange of information on carbon flux observations in Asia. The executive office is now in CGER and issues a quarterly newsletter in both English and Japanese.

The Global Carbon Project. The Global Carbon Project's goals are to integrate "Human Dimensions" into the integrated earth system science of the global carbon cycle; focus on carbon management; and support carbon cycle research throughout the world. A high priority is the development of the RC6 Initiative, a comparative and historical approach to urban, regional, and global carbon footprints, as well as their determinants, trajectories, and management opportunities. RC6 stands for "Regions, Cities, Carbon, Culture, Climate, Change, and Consequences." RC6 relies on an understanding of the place-based of POETICs (Population, Organization, Environment, Technology, Institutions, and Culture) as drivers of carbon emissions and land-use change.

Symposium on Utilization of the Greenhouse Gases Observing Satellite (GOSAT)

21 April 2004
Hitotsubashi Memorial Auditorium
Chiyoda, Tokyo

To promote understanding and utilization of the Greenhouse Gases Observing Satellite (GOSAT), a Symposium on the Utilization of GOSAT was held in Tokyo by the Ministry of the Environment, the Japan Aerospace Exploration Agency, and the National Institute for Environmental Studies. Prof. Berrien Moore III of the University of New Hampshire, and Prof. Yoshifumi Yasuoka of the University of Tokyo were invited as keynote speakers. They demonstrated the advantage of satellite observation for effective monitoring of greenhouse gases on Earth. Also, a panel discussion was held by domestic and international academics on global warming issues, the necessity for CO_2 observations, and the status of the GOSAT project.

International Symposium on Global Environment Monitoring

23–24 April 2004
National Museum of Emerging Science and Innovation (Kagaku-Miraikan)
Koutou, Tokyo

The aim of the Symposium was to introduce the global environment monitoring activities conducted by NIES and to facilitate further discussion of effective ways to promote global environment monitoring in close collaboration with the counterparts of NIES around the world. This symposium was organized as an official side event of the second Earth Observation Summit held in Tokyo. Many earth observation managers and researchers from both Japanese and overseas and international organizations participated in the symposium. The total number of participants was 270, making the symposium one of the biggest side events of EOS II.

IGES/NIES Open Symposium, "International Climate Regime beyond 2012: Issues and Challenges"

9 September 2004
Fukoku Seimei Building
Chiyoda, Tokyo

This open symposium was held to discuss the near-term actions that can be taken as part of long-term efforts to stabilize greenhouse gas concentrations in the atmosphere. As well as presentations by experts from Japan, the USA, Europe and Indonesia, there was a panel discussion to enhance understanding of the theme, allowing plenty of time for questions from the floor.

Meeting for the Global Taxonomy Initiative and Capacity Building in Biodiversity Information Sharing

29 September 2004
NIES Tokyo Office
Chiyoda, Tokyo

To identify the need for biodiversity information and Japan's required roles and actions in this field, various researchers, officials, and stakeholders discussed how best to input Japan's view in the future governance and operation of the GBIF. Every participant agreed on future cooperation for biodiversity information-sharing among related organizations and researchers.

Tripartite Presidents Meeting (TPM) among NIES, NIER, and CRAES

12–15 October 2004
Tsukuba International Congress Center
Tsukuba, Ibaraki

This Meeting aimed to expedite joint efforts toward environmental research among Japan, Korea, and China, while seeking cooperation on issues of common interest. The Second TPM was held in Tsukuba, Japan on 12–14 October 2004. The three presidents have agreed to explore possibilities for joint projects in the areas of fresh water pollution; air pollution (including from vehicular sources); transboundary air pollution; yellow sand storms; hazardous materials contamination (for example, with endocrine-disrupting chemicals and persistent organic pollutants—POPs); and migratory birds and wetlands. The next meeting in 2005 will be hosted by NIER.

APGC Post Flux Meeting

22–23 October 2004
NIES
Tsukuba, Ibaraki

This meeting was intended to enhance information exchanges on the development of monitoring research of carbon cycle in terrestrial ecosystems, i.e., flux observation in forested areas, Researchers in NIES and other Asian research organizations presented their recent research results.

UNU-IAS/NIES Yokohama Round Table on the Future Direction of Climate Change Regimes

10 November 2004
UNU-IAS
Yokohama, Kanagawa

UNU-IAS and NIES convened this round table to consider the future directions of international climate change regimes. We heard and discussed presentations by Japanese and non-Japanese experts on post-2012 from different perspectives. We presented our analysis of proposals for post-2012 and offered three plausible scenarios that describe the world in the next decade, in ways that are likely to affect the debate on future climate regimes.

NIES Commemorative Lecture by Blue Planet Award 2004 Winners

12 November 2004
NIES
Tsukuba, Ibaraki

NIES invited Dr. Susan Solomon and Dr. Gro Harlem Brundtland to give the NIES Commemorative Lecture by Blue Planet Award 2004 Winners. Over 200 researchers, officials, and stakeholders attended the lecture and the discussion that followed.

Third Workshop on Material Cycles and Waste Management in Asia (NIES E-waste Workshop)

14–15 December 2004
NIES
Tsukuba, Ibaraki

In light of continuing economic growth and the increasing transboundary movement of secondary resources in Asia, endeavors toward both implementation of the 3Rs (Reduce, Reuse, Recycle) in each country and the appropriate control of international material cycles are required. To improve our understanding of the current status of E-waste issues in the context of international material cycles and to discuss future 3R tasks in each country/region, NIES organized the Third Workshop on Material Cycles and Waste Management in Asia (NIES E-waste Workshop).

Third Japan-EU Workshop on Climate Change Research

20–21 January 2005
Frontier Research Center for Global Change (FRCGC)
Yohohama , Kanagawa

The Workshop was organized under the framework of the Japan–EU Science and Technology Forum, with the main objective of further promoting closer links and collaboration in the field of climate change research. The Workshop provided a valuable forum for the exchange of information on the ongoing activities of Japanese climate change research programs, including the "Project for Sustainable Coexistence of Human, Nature and the Earth" and GOSAT-related projects, and the Sixth EU Framework Program, Sub-priority "Global Change and Ecosystems". It was recognized that common objectives exist between these programs and provide new opportunities for further strengthening research cooperation in the near future.

Program of "Tokyo Triple Workshops on Material Flow Analysis, Input–Output Analysis and Environmental Accounting"

8–10 February 2005
NIES Tokyo Office
Chiyoda, Tokyo
Koku-Kaikan
Minato, Tokyo

This program consisted of 3 Workshops on material cycles. The theme of each workshop was: WS-A (8 February) "Environmental Burdens Associated With International Trade of Raw Materials, Known as Ecological Rucksack Or Hidden Flows"; WS-B (9 February) "Further Application of Input–Output Tables to Microscopic and Macroscopic Environmental Analysis"; and WS-C (10 February) "Environmental Accounting in Micro (Company), Meso (Sector, Region), and Macro (National Economy) Levels"

Second Workshop on GHG Inventories in the Asia Region

7–8 February 2005
Shanghai Marriott Hotel
Shanghai, China

The Workshop was organized by the Ministry of the Environment, Japan, and the National Institute for Environmental Studies, Japan, and was hosted by the Chinese Research Academy of Environmental Science. Objectives of the meeting were to (1) update each other on the very latest status of GHG inventories in Asia; (2) share useful information and experiences in GHG inventory preparation; and (3) discuss the future activities of the Asian network.

Open Symposium on "Low-Carbon Society Scenario toward 2050: Scenario Development and its Implication for Policy Measures"

24 March 2005
Shinagawa Prince Hotel
Shinagawa, Tokyo

The purpose of this symposium was to bring Japanese researchers and stakeholders on climate change to a common forum, and to inform them of national-level climate policy scenarios toward 2050 that have been developed in the UK, Germany, Netherlands, France, and other countries. Our concerns are how to develop those scenarios and evaluate their impact on policy measures, which include: (i) the rationale behind the selection of reduction targets; (ii) how to evaluate reduction measures and their economic impacts; and (iii) how to chart an implementation roadmap. This symposium was an important activity of the new research project "Low-Carbon Society Japan 2050", which has been sponsored by the Ministry of Environment, Japan, since 2004

Bioinformatics Forum: Names and Objects for Unambiguous Data Access amongst Biodiversity Data Entities

14–15 March 2005
NIES
Tsukuba, Ibaraki

NIES established common XML schema within the scientific name database with University of Michigan. This Meeting discussed further developments in research on a model for biological species database objects.

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

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

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

CHINA
1. Advanced wastewater treatment processes for China
Research Institute for Environmental Engineering/Dept. Environmental Engineering, Tsinghua Univ.
Research Center for Material Cycles and Waste Management
2. Advanced sewage treatment processes by soil system applicable to China
Institute of Applied Ecology, Chinese Academy of Sciences
Research Center for Material Cycles and Waste Management
3. Development of wastewater and water resources treatment processes applicable to China
Chinese Research Academy of Environmental Sciences
Research Center for Material Cycles and Waste Management
4. Research on the development of water pollution control techniques for the Taihu Lake in China by bio/ecoengineering
Chinese Research Academy of Environmental Sciences
Research Center for Material Cycles and Waste Management
5. Dioxins analysis and survey of dioxins sources in China
China-Japan friendship Center for Environmental Protection Center
Environmental Chemistry Div.
6. Development of eco-engineering technologies for the control of eutrophication in the drainage area Honfeg Lake and Baihua Lake in China Guizhou
Guizhou Provincial Environmental Protection Bureau
Research Center for Material Cycles and Waste Management
7. Study on transport mechanism of kosa aerosol to Japan by way of Beijing
Sino-Japan Friendship Environmental Protection Center
Environmental Chemistry Div.
8. Research on development of suitable technologies to control greenhouse gas emissions during the treatment of domestic wastewater using bio-eco engineering system
Shanghai Jiao Tong University
Research Center for Material Cycles and Waste Management
9. Satellite Monitoring of Environmental Resources Asia by means of EOS-MODIS data
Institution of Geografica Sciences and Natural Resources, Chinese Academy of Sciences
Water and Soil Environment Div.
10. Molecular Epidemiological studies on the health effect of arsenic
Institution of Environmental Health and Engineering, Chinese Academy of Preventive Medicine
Environmental Health Sciences Div.
11. Research on VOCs &Ammonia emission in China
Chinese Research Academy of Environmental Science
Environmental Health Sciences Div.

CZECH
1. Biogeochemical studies on the acidic deposition and pollutions
Institute of Landscape Ecology, Czech Academy of Sciences
Atmospheric Environment Div.
2. Perception of Landscape: form Landscape Appreciation to Landscape Planning
Institute of Landscape Ecology, Czech Academy of Sciences
Social and Environmental Systems 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. Biodiversity of microalgae obtained from the Atlantic and the Pacific Ocean
University of Caen
Environmental Biology Div.

6. Hormonal regulation of the toxicity of environmental pollutants
INSELM U469
Regional Environment Div.

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

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

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

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

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

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. Underway measurement of pCO_2 in the surface water of the Arctic Ocean
   Goteborg University
   Climate Change Research Project
2. Health risk assessment of heavy metal exposure: Effects of increase in human activity
   Kalolinska Institute
   Environmental Health Sciences Div.

U. K.

1. *In vivo* NMR spectroscopy method and its application to the field of environmental health
   Dept. Biochemistry, Univ. Cambridge
   Endocrine Disrupters & Dioxin Research Project
2. Effects of environmental pollution on the metabolism of trace elements in man
   Rowett Research Institute
   Environmental Health Sciences Div.
3. Algae and Protozoa
   CCAP, Institute of Freshwater Ecology
   Environmental Biology Div.
4. Cooperation on the development and application of Coupled Chromatography-Accelerator Mass Spectrometry Techniques
   University of Oxford
   Environmental Chemistry Div.
5. Mechanisms of phagocytic activities in alveolar macrophages
   University of Oxford
   Environmental Health Sciences Div.

U. S. A.

1. Development of bioremediation technologies for cleanup of contaminated soil
   Center for Environmental Biotechnology, Univ. Tennessee
   Water and Soil Environment Div.
2. Precise measurement of the greenhouse gases in the global baseline atmosphere
   Climate Monitoring and Diagnostic Lab, NOAA
   Center for Global Environmental Research
3. Health impacts of climate change and environmental degradation of human morbidity in regional societies
   National Institute of Environmental Health Sciences
   Regional Environment Div.
4. Effects of logging on lakes ecosystems
   University of Alaska Fairbanks
   Regional Environment Div.
5. Human impacts on biodiversity and nutrient cycling in mire wetland
   Smithsonian Institute
   Environmental Biology Div.
6. Establishment of phytotron research network
   Duke University
   Environmental Biology Div.
7. Studies on standardization of measurement and health effect of particulates
   USEPA, National Center of Environmental Assessment
   Environmental Health Sciences Div.
8. Studies on the feasibility of the FTIR network for vertical profiling atmospheric trace species
   University of Denver
   Atmospheric Environment Div.
9. Development of an advanced regional climate change prediction model as part of emission-climate-impact integrated models
   Goddard Space Flight Center, NASA
   Atmospheric Environment Div.
10. Joint implementation of ocean surface CO_2 observation in the Pacific Ocean to understand the oceanic sink of CO_2
    Pacific Marine Environmental Laboratory, NOAA
    Climate Change Research Project
11. Collaboration on greenhouse gas observation from space
    Jet Propulsion Laboratory
    Center for Global Environmental Research
12. Joint implementation of CO_2 flux observations for the identification of carbon fixation ability of forests and the prediction of its fluctuation
    Department of Energy (DOE)
    Center for Global Environmental Research
13. Comparative, standardized and complementary measurement of atmospheric constituents for the evaluation of terrestrial/oceanic sources and sinks of carbon, other non- CO_2 greenhouse gases and aerosols
    Climate Monitoring and Diagnostics Laboratory, NOAA
    Center for Global Environmental Research

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

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

Agreement on Cooperative Research Projects between the National Institute for Environmental Studies, Environment Agency of Japan and the Institute of Hydrobiology, Chinese Academy of Sciences (1995).

Memorandum of Understanding between Institute of Hydrobiology, Chinese Academy of Sciences, People'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 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).

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Implementing Agreement between the National Institute for Environmental Studies of Japan and National Institute of Environmental Research of the Republic of Korea to establish a cooperative framework regarding endocrine disrupting chemicals research (1999).

MALAYSIA Memorandum of Understanding between the Forest Research Institute Malaysia (FRIM), the University Pertanian Malaysia (UPM) and the National Institute for Environmental Studies, Japan (NIES) for Collaborative Research on Tropical Forests and Biodiversity (2003 amended).

RUSSIA	Agreement on a Joint Geochemical Research Program; Impact of Climatic Change on Siberian Permafrost Ecosystems between the Permafrost Institute Siberian Branch, Russian Academy of Sciences, Russia and the National Institute for Environmental Studies, Japan (1992).
	Agreement on a Cooperative Research Project between the Central Aerological Observatory, Committee for Hydrometeorology and Monitoring of Environment, Ministry of Ecology and Natural Resources, Russian Federation and the National Institute for Environmental Studies, Japan (1992).
	Agreement on a Cooperative Research Projects between National Institute for Environmental Studies, Environment Agency of Japan and Institute of Atmospheric Optics, Russian Academy of Sciences (1997).
	Agreement on Cooperative Research Project between Institute of Solar-Terrestrial Physics (ISTP), Siberian Branch, Russian Academy of Science and National Institute for Environmental Studies, Environment Agency of Japan.
THAILAND	Memorandum of Understanding between Kasetsart Unversity, Bangkok, Thailand and National Institute for Environmental Studies, Japan (NIES) for Global Taxonomy Initiative, Toxic, Cyanobacteria and Algal Diversity (2002).
UN	Memorandum of Understanding referring to the Establishment and operation of a GRID-compatible Center in Japan (1991).
CHINA & KOREA	The Second Tripartite Presidents Meeting among NIES, NIER and CRAES Joint Communique (2004).

<Host Division>
Researcher, COUNTRY, Research Period
Research Subject (Host Researcher)

<Office of International Coordination>

An, Ping, CHINA, 2004. 10. 1 ～ 2005. 3. 31
Conservation of vegetation affected by global environmental problems (Atmospheric pollution in desertificated area) (Shimizu, H.)
An, Ping, CHINA, 2004. 10. 1 ～ 2005. 3. 31
A pilot study in North-East Asia for developing desertification assessment and constructing an early warning system (3) Land vulnerability assessment by soil/vegetation/hydrological analysis (Shimizu, H.)
Chen, Lijun, CHINA, 2004. 7. 1 ～
A pilot study in North-East Asia for developing desertification assessment and constructing an early warning system (3) Land vulnerability assessment by soil/vegetation/hydrological analysis (Shimizu, H.)
Shi, Peijun, CHINA, 2004. 10. 5 ～ 2004. 10. 26
Desertification in arid/semi-arid land in China with special reference to wind sand storm (Shimizu, H.)
Simbolon, Herwint, INDONESIA, 2005. 2. 1 ～ 2005. 3. 31
Conservation of vegetation affected by global environmental problems (Tropical forest fire) (Shimizu, H.)
Tian, Junliang, CHINA, 2004. 10. 17 ～ 2004. 12. 12
Assessment of desertification at village-level and catchment-level in Loess Plateau (Shimizu, H.)
Yu, Yunjiang, CHINA, 2002. 10. 2 ～ 2004. 10. 1
Researches on the mechanism of influence of aeolian sand flow on the ecophysiology of plants and adaptability of these plants to aeolian sand flow (Shimizu, H.)
Yu, Yunjiang, CHINA, 2004. 10. 2 ～ 2005. 3. 31
A pilot study in North-East Asia for developing desertification assessment and constructing an early warning system (Shimizu, H.)
Zheng, Youbin, CANADA, 2004. 10. 1 ～ 2005. 3. 31
Conservation of vegetation affected by global environmental problems (Climate change and atmospheric pollution) (Shimizu, H.)
Zheng, Yuanrun, CHINA, 2004. 10. 1 ～ 2005. 3. 31
A pilot study in North-East Asia for developing desertification assessment and constructing an early warning system (Shimizu, H.)

<Social and Environmental Systems Division>

Arlt, Wolfgang Georg, GERMANY, 2004. 12. 28 ～
Effects of change of communication on the social environment at Japan sea area (Aoki, Y.)
Cudlinova, Eva, CZECH REPUBLIC, 2004. 10. 1 ～
Comparison of Landscape appreciation between Japanese and Czech (Aoki, Y.)
Idip, David, PALAU, 2004. 6. 1 ～ 2005. 3. 31
Habitat mapping in Palau using satellite data (Yamano, H.)
Lange, Eckart, GERMANY, 2004. 3. 29 ～ 2004. 4. 30
Comparison of Landscape appreciation between Switzerland and Japan. (Aoki, Y.)
Miloslav, Lapka, CZECH REPUBLIC, 2004. 10. 1 ～
Comparison of Landscape appreciation between Japanese and Czech (Aoki, Y.)
Nair, Rajesh, INDIA, 2004. 4. 1 ～ 2005. 3. 31
Non CO_2 GHG Emissions in India: Trends and Mitigation Flexibility (Kainuma, M.)
Wan, Yue, CHINA, 2004. 5. 10 ～ 2005. 3. 31
Model Analysis of Health impact due to global warming in China (Masui, T.)

<Environmental Chemistry Division>

Alam, Md. Jahangir, BANGRADESH, 2004. 12. 1 ～ 2005. 3. 31
Radiocarbon of riverine particulate organic matter (Aramaki, T.)
Dang, Phong Xuan, VIET NAM, 2004. 5. 12 ～ 2004. 6. 14
Environmental change of Indochina in the 20th century: Reconstruction from coral annual bands (Shibata, Y.)
Kim, Ki Tae, KOREA, 2005. 1. 11 ～ 2005. 2. 17
The study on in vivo bio-assay for chemical pollution and application for field surveys of aquatic organisms (Tatarazako, N.)
Treuner, Anke Britt, GERMANY, 2002. 11. 29～2004. 11. 28
Studies on the effects of organotins on survival, behaviour and development of abalone larvae and investigations into mode of action of gastropod imposex development with the use of a novel tissue and organ culture system (Horiguchi, T.)

<Environmental Health Sciences Division>

Lee, Jae-Seong, KOREA, 2004. 7. 23 ～ 2004. 8. 22
Construction of medaka (Oryzias latipes) cDNA chip and its use on molecular and environmental toxicogenomic study (Ohsako, S.)

<Atmospheric Environment Division>

Li, Hong, CHINA, 2004. 4. 1 ～ 2005. 3. 31
Studies on chemical components of organic aerosols transported from East Asia (Hatakeyama, S.)
Tatarov, Boyan, BULGARIA, 2004. 4. 1 ～
Study for determining climatology of lidar ratio using a high-spectral-resolution lidar (Sugimoto, N.)

<Water and Soil Environment Division>

Chen, Xi, CHINA, 2004. 4. 1 ～ 2004. 4. 30
Research on Water Control and Management System of Tarim River (Watanabe, M.)
Hou, Hong, CHINA, 2004. 4. 1 ～ 2005. 3. 31
Behavior of rare metals in soil, which are used in next generation technology (Takamatsu, T.)
Kim, Daekyung, KOREA, 2004. 4. 1 ～ 2004. 12. 31
Molecular level analyses on the mechanism of toxic action found in the red tide phytoplankton (Watanabe, M.)
Li, Maotian, CHINA, 2004. 7. 18 ～ 2005. 3. 31
Long-term variations in dissolved silicate flux from the Yangtze River into the East China Sea and impacts on estuarine ecosystem (Watanabe, M.)

Liu, Chen, CHINA, 2004. 4. 1 ～ 2004. 12. 31
Food style and distribution structure in China: present and future (Otsubo, K.)
PARK, Sang-Cheol, KOREA, 2005. 1. 11 ～ 2005. 2. 17
Effects of dissolved organic matter on drinking water treatment processes (Imai, A.)

<Environmental Biology Division>

Ellis, Brian Edward, CANADA, 2004. 10. 16 ～ 2004. 10. 30
MAPK signalling and cell survival in response to environmental oxidant stress (Kubo, A.)
Hashim, Mazlan, MALAYSIA, 2005. 1. 8 ～ 2005. 3. 31
Risk assessment on landscape development using GIS approaches (Okuda, T.)
Mulpuri, Rao Venkateswara, INDIA, 2004. 10. 18～2004. 10. 31
Clarification of mechanism of plant resistance to ozone (Saji, H.)
Noel, Mary-Helene, FRANCE, 2004. 4. 1 ～
Biodiversity of the benthic microalgae in a mangrove-fringed tidal creek, Ranong Biosphere Reserve,Southwest Thailand (Kasai, F.)
Papker, Kennith Ross, CANADA, 2004. 4. 1 ～
Cavity usage and characteristics of cavity substrates in the Pasoh Research Forest, Malaysia (Okuda, T.)
Yusop, Zulkifli, MALAYSIA, 2005. 1. 16 ～ 2005. 3. 31
Studies on Evaluation of Logging Impacts on Soil Erosion and Watershed Ecosystem:Results on Soil and Nutrient losses (Okuda, T.)
Yongmanitchai, Wichien, THAILAND, 2004. 3. 23 ～ 2004. 5. 6
Collaborative research on microalgal diversity in a tropical region and the culture collection (Kasai, F.)
Zhang, Yongqiang, CHINA, 2004. 7. 1 ～ 2005. 3. 31
Inclusion photoinhibition in simulation of carbon dynamics in an alpine meadow on the Qinghai-Tibetan Plateau (Tang, Y.)

<Climate Change Research Project>

Chierici, Melissa, SWEDEN, 2004. 4. 1 ～ 2004. 10. 31
Comparison of oceanic sink and source of carbon dioxide in the Pacific and Atlantic oceans with data integration of observational data sets (Nojiri, Y.)
Fransson, Agneta Ingrid, SWEDEN, 2002. 9. 25～2004. 9. 24
Analysis of CO_2 source and sink in the North Pacific and the role of iron as a controlling factor (Nojiri, Y.)
Heike, Lueger, GERMANY, 2004. 6. 10 ～ 2004. 8. 10
Comparison of ocean surface partial pressure of CO_2 of North Atlantic and North Pacific (Nojiri, Y.)

<Endocrine Disrupters and Dioxin Research Project>

Lee, Moon-Soon, KOREA, 2004. 4. 1 ～
Research on the methodology of risk assessment by environmental chemicals (Suzuki, N.)
Manila, Sedqyar, AFGHANISTAN, 2004. 4. 1 ～ 2005. 3. 31
Study on endcrine control system of quail's gonad (Takahashi, S.)

<Biodiversity Conservation Research Project>

Jang, Mih-Ho, KOREA, 2004. 10. 21 ～
Changes in toxin production by cyanobacteria exposed to food-web components (Takamura, N.)
Kyong, Ha, KOREA, 2004. 11. 1 ～
Prey-predator interaction focused on cyanobacterial toxin production (Takamura, N.)

<Research Center for Material Cycles and Waste Management>

Hu, Zhanbo, CHINA, 2005. 2. 1 ～
Development of technology to control greenhouse gas emissions from soil domestic wastewater treatment process (Inamori, Y.)
Kim, Juhyun, KOREA, 2004. 4. 1 ～ 2005. 3. 31
Development of Nitrogen, Phosphorus removal, recovery system for stock farm wastewater treatment (Inamori, Y.)
Kwon, Oh Jung, KOREA, 2005. 1. 11 ～ 2005. 2. 17
Water retention energy analysis of multi-functional final cover system for final disposal sites (Inoue, Y.)
Le, Van Chieu, VIET NAM, 2004. 12. 13 ～ 2004. 12. 19
Development of appropriate management technology for hazardous waste and wastewater (Ishigaki, T.)
Nguyen, Thi Diem Trang, VIET NAM, 2004. 12. 13 ～ 2004. 12. 15
Development of appropriate management technology for hazardous waste and wastewater (Ishigaki, T.)
Sandulescu, Elena Maria, RUMANIA, 2004. 9. 1 ～ 2004. 12. 31
Comparative study of Lead Substance Flow and Environmental Risk between Europe & Japan: Production, Recycling and Waste Management (Sakai, S.)
Tua, Tran Van, VIET NAM, 2004. 7. 12 ～ 2004. 10. 10
Monitoring of cyanobacterial toxin in environmental water (Inamori, Y.)
Yan, Li, CHINA, 2005. 2. 1 ～
Development of technology to control greenhouse gas emissions from soil plant domestic wastewater treatment process (Inamori, Y.)

<Research Center for Environmental Risk>

Hong, Han Na, KOREA, 2005. 1. 11 ～ 2005. 2. 17
Development of a microtitor plate method for evaluating the interaction of nuclear receptors (NRs) and chemicals using recombinant proteins (Shiraishi, H.)

<Center for Global Environmental Research>

Maksyutov, Shamil, RUSSIA, 2004. 4. 1 ～ 2005. 3. 31
Modeling global atmospheric CO_2 transport and surface fluxes (Inoue, G.)
Sha, Weiming, CHINA, 2004. 10. 1 ～ 2005. 3. 31
Development of non-hydrostatic numerical models for the geophysical fluid dynamics of the global and regional atmosphere (Inoue, G.)
Yang, Yufang, CHINA, 2004. 4. 1 ～ 2005. 3. 31
Research on Pilot Project on Mekong River Ecosystem Monitoring (Ichinose, T.)
Zhang, Qianbin, CHINA, 2004. 4. 1 ～ 2005. 3. 31
GEMS/Water Lake Mashu baseline monitoring (Fujinuma, Y.)

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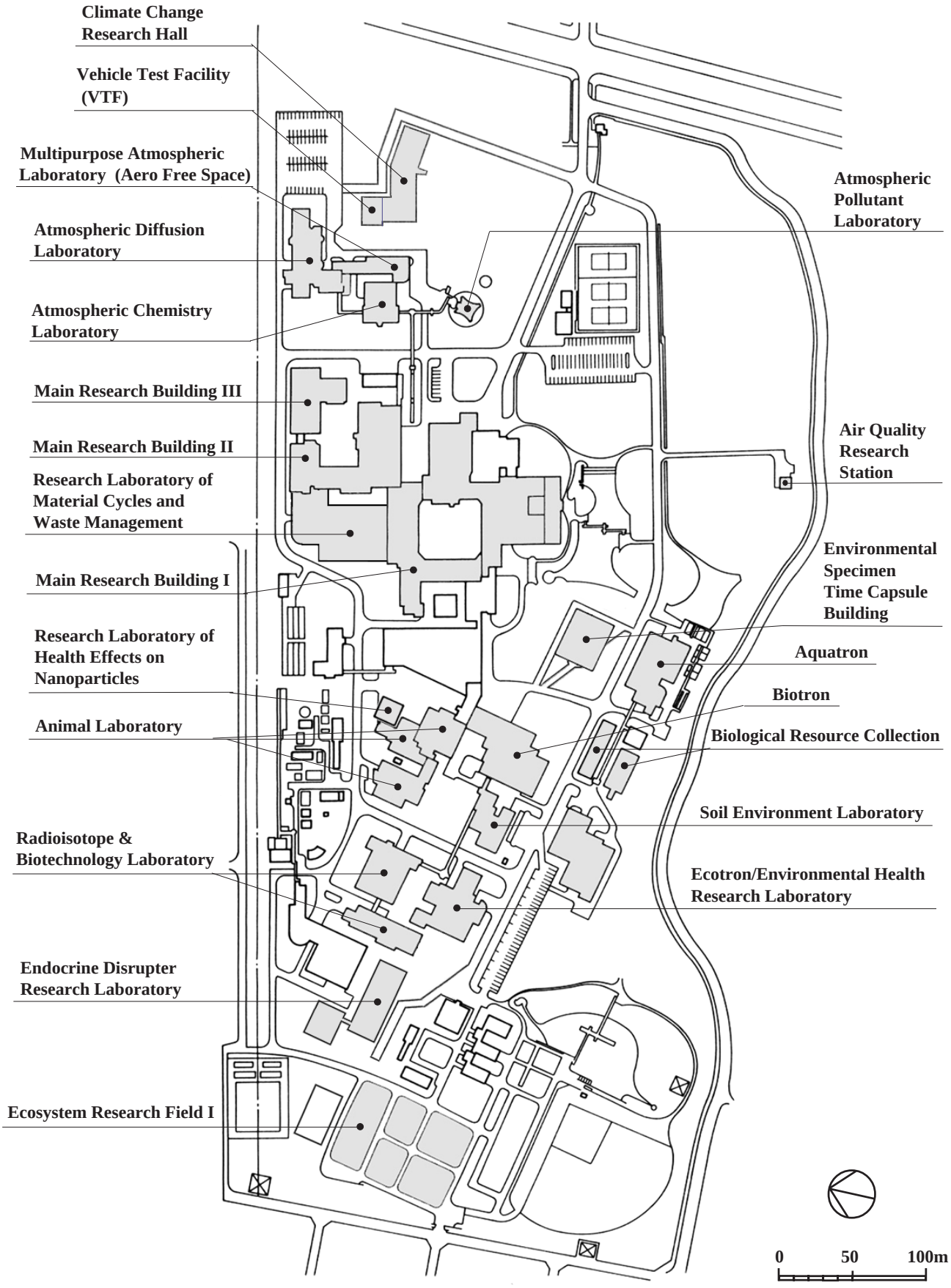
Climate Change Research Hall
Vehicle Test Facility (VTF)
Multipurpose Atmospheric Laboratory (Aero Free Space)
Atmospheric Diffusion Laboratory
Atmospheric Chemistry Laboratory
Main Research Building III
Main Research Building II
Research Laboratory of Material Cycles and Waste Management
Main Research Building I
Research Laboratory of Health Effects on Nanoparticles
Animal Laboratory
Radioisotope & Biotechnology Laboratory
Endocrine Disrupter Research Laboratory
Ecosystem Research Field I
Atmospheric Pollutant Laboratory
Air Quality Research Station
Environmental Specimen Time Capsule Building
Aquatron
Biotron
Biological Resource Collection
Soil Environment Laboratory
Ecotron/Environmental Health Research Laboratory
0
50
100m

Air Quality Research Station
Automatic instruments to monitor the concentrations of 7 atmospheric constituents (NOx, SO_2, O_3, CO_2, non-methane hydrocarbons, suspended particulate matter, and gaseous Hg) are operated at this station. Wind speed, precipitation, atmospheric pressure, visible and UV radiation, earth surface (soil and air) temperature and other atmospheric characteristics are also measured for data analyses, and the results are made available to NIES researchers. The stability and accuracy of the automated measurements and factors that interfere with them are studied, as is the evaluation of new instruments deveioped for atmospheric monitoring.

Animal Laboratory
The animal laboratory has three facilities, in which environmental conditions are controlled. Facility I has breeding rooms for specific pathogen-free laboratory animals, and has complex gas or diesel exhaust particles (DEP) exposure chambers for investigating the health effects of PM2.5 or DEP. Facility II has a conventional laboratory animal breeding unit and has laboratories for studies on the effects of chemicals, including dioxins and heavy metals. Facility III was built in 2004 as a nanoparticle health effect research facility; it contains exposure chambers and two diesel engines for generating nanoparticles Research on the health effect of nanoparticles on experimental animals will begin in the 2005 fiscal year.

Aquatron
This hydrobiological laboratory includes several related special facilities. The freshwater microcosm is particularly suitable for studies of the mechanisms and dynamics of phytoplankton bloom formation. 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 Chemistry Laboratory
This is a 6-m^3 stainless steel chamber, the inner surface of which is coated with Teflon. It permits studies of atmospheric photochemistry. This facility is essential to our research on the photochemistry of urban smog, mechanisms for secondary aerosol formation, and other important atmospheric phenomena.

Atmospheric Diffusion Laboratory
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.

Biological Resource Collection
Two projects are conducted in this facility; one is the Microbial Culture Collection (MCC-NIES), in which microalgae and protozoa have been maintained since 1983. About 1900 strains have now been preserved, and 600 to 800 strains are distributed to researchers inside and outside NIES each year. In 2002, MCC-NIES was made a center for the collection of algal resources in Japan. The other is *ex situ* conservation of endangered algae (as a part of the Environmental Specimen Time Capsule Program). About 200 strains of freshwater red algae and Charales algae are maintained.

Biotron
This facility consists of controlled greenhouses and growth cabinets used to evaluate the effects of various detailed environmental scenarios on organisms. It includes experimental chambers in which light, temperature, and humidity can be precisely controlled. It also facilitates exposure of experimental plants to pollutant gases under these controlled conditions

Climate Change Research Hall
Climate Change Research Hall (CCRH), built especially for global warming research, was completed in March 2001 with 3 floors and a total area of 4900m^2. The following major research programs are conducted in this new facility: (1) development and implementation of climate change models based on various socio-economic and emissions scenarios; (2) monitoring of atmospheric constituents to evaluate ocean and terrestrial carbon sinks; and (3) assessment of forest sinks by remote sensing, forest modeling and use of statistical data. In addition, the facility includes equipment to evaluate low-emissions vehicles. CCRH was constructed various new energy saving. The effectiveness of energy saving is being monitored and analyzed.

Ecosystem Research Field
The Ecosystem Research Field is composed of the main field I and the branch field II, which is located 4 km west of the main field. The facilities include fields for rice, crop plants, shrubs, and trees; lysimeters; greenhouses; observation towers; and laboratories. This field is used to test the results of indoor experiments on plant and soil functions in ecosystems; to develop remote-sensing techniques from small-scale ground truth data; and to supply plants, particularly for bioassays and bioremediation.

Endocrine Disrupter Research Laboratory

The Endocrine Disrupter Research Laboratory was founded in March 2001 for studies on the analysis, bioassay, and experimental hazard/risk assessment of endocrine disrupting chemicals (EDCs), as well as for carrying out field surveys and assessing management technologies for these substances. The building has 4 floors with a total area of 5200m^2, and is equipped with several special instruments, including a high-resolution nuclear magnetic resonance imaging (MRI) instrument for examining the activity of the living human brain, and a liquid chromatograph –tandem mass spectrometry (LC/MS/MS) for the qualitative and quantitative analysis of EDCs. The laboratory has all the necessary basic laboratory functions for chemical and biological research on EDCs, and is also intended to strengthen research collaboration with domestic and overseas researchers for the further development of research on endocrine disrupters.

Environmental Specimen Time Capsule Building

The strategic and systematic storage of environmental samples and biological specimens provides an important knowledge base and is essential for environmental research.

For example, such samples and specimens are needed to study long-term trends in environmental pollutants, and to verify past conditions when new types of pollution have been identified. NIES constructed this new building to provide central facilities for the preservation of environmental specimens. The facilities will be used for the long-term storage of environmental specimens such as soil and air particles, as well as of the cells and genetic material of threatened species.

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 greenhouse gases at remote sites in Japan. The island of Hateruma is located in Okinawa Prefecture and is the nation's southernmost inhabited island. The monitoring station was constructed on the eastern edge of Hateruma. Cape Ochi-ishi Station is located in the eastern part of Hokkaido, which is a northern district of Japan. These stations are automated systems for high-precision monitoring of greenhouse gases(e.g.CO_2, CH_4, N_2O, O_3,) and other atmospheric species (NOx , SO_2, SPM). Long-term monitored data are archived and distributed through the Center for Global Environmental Research (CGER) homepage and World Data Center for Greenhouse Gases (WDCGG).

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

Preservation Laboratory

This facility includes –20˚C, 5˚C and 20˚C temperature-controlled rooms, where various environmental substances collected by researchers at this Institute are stored temporarily in advance registration, until they are put to practical use in the near future. Some samples that are recognized as valuables for study are transferred to regular storage in the time capsule building.

Main Research Building III

1) Fourier-transform mass spectrometer (FT-MS)

The FT-MS has very high mass resolution–, more than 10^6 at m/z = 131–, with a superconducting magnet rated at 3 T. 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 MSs are connected serially (in tandem). The resolutions of the first and second MSs are 6.5×10^4 and 5×10^3, respectively. Ions selected by the first MS are passed through the collision cell, where the ions yield fragments, which are then analyzed by the second MS. The chemical structures of complex molecules can be determined with this instrument.

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 electrical charges of their nuclei. The AMS is a very sensitive and selective method for atomic ion detection and is used for measuring long-lived radioisotopes such as ^{14}C and ^{10}Be. These radioisotopes are used as tracers and time-markers (dating agents) in environmental research.

4) Hazardous chemicals area

Experiments using highly toxic substances, such as dioxins (chlorinated dibenzodioxins), polychlorinated biphenyls (PCBs), and poly-chlorinated dibenzofurans, are conducted in this area. The air pressure inside the area is maintained below atmospheric pressure to, prevent leakage of hazardous substances in the analytical laboratory. Exhaust air is treated by high-efficiency perticulate air (HEPA) filters and charcoal filters; discharge water is also treated with a charcoal filter system. The Hazardous Chemicals Area contains an analytical lab with 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 (DHF) for the Improved Limb Atmospheric Spectrometer II (ILAS-II)

ILAS-II is a satellite-borne sensor used to measure atmospheric constituents such as ozone, nitric acid, and water vapor in the polar stratosphere. It was developed by the Ministry of the Environment of Japan. ILAS-II was aboard the Advanced Earth Observing Satellite II (ADEOS-II: named “Midori II”), which was launched on 14 December 2002. ADEOS-II operated routinely from April to October 2003. The ILAS-II measurement data were processed, re-processed, archived, and distributed by the ILAS-II DHF. The ILAS-II data products are used for atmospheric research work by NIES researchers and by other registered researchers.

6) Millimeter-wave spectrometer system for observation of atmospheric ozone

The millimeter-wave spectrometer measures the emission spectra from rotational transition of ozone molecules in the stratosphere and mesosphere with extremely high resolution. Vertical profiles of ozone from 14 to 76 km are retrieved by using the dependence of the width of the emission spectra of ozone on altitude. The spectrometer was installed in 1995. Since then, ozone has been monitored continuously, except on rainy days and heavily humid days.

7) Receiving and Processing facility for NOAA satellite data

The Advanced Very High Resolution Radiometer (AVHRR) instruments orbit the earth on National Oceanic and Atmospheric Administration (NOAA, USA) satellites. They monitor 5 electromagnetic radiation wavelength bands from the visible to the thermal infrared region with high temporal and relatively medium spatial resolution (ca. 1 × 1 km). The AVHRR facility of NIES was able to receive the data, which are obtained by various AVHRRs, up to March 2004. The data received up until that time are being processed and archived by the facility.

8) Information processing center for Global Resouce Infomation Database (GRID)-Tsukuba

GRID-Tsukuba is part of the 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 datasets. 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.

Oku-Nikko Field Research Station

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

Radioisotope and Biotechnology Laboratory

This 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. The laboratory’s specialized instruments, including a peptide sequencer and a DNA sequencer, are available on the first floor. The second floor is radioisotope-controlled area used to facilitate studies of the transport, accumulation, chemical conversion, and toxicity of environmental pollutants in plants, animals, soil, water, and the atmosphere.

Research Laboratory of Material Cycles and Waste Management

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

Research Station for Preservation and Enhancement of Water Environment

1) Lake Kasumigaura Water Research Laboratory

This field station, located on the shore of Lake Kasumigaura, is used as a common research 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.

2) Bio-Eco Engineering Research Laboratory

Improving water quality in enclosed water bodies is an important environmental issue in many countries around the world. If water-cleaning technologies are used, it is essential that they be properly suited to the local conditions. In this laboratory, research, development, and actual field testing of new types of waste and wastewater treatment systems, such as the advanced Johkasou system and aquatic plant–soil application processes that use bio- and eco-engineering technologies, are being promoted. This laboratory will enhance research activities, including international cooperative research.

Research Laboratory of Health Effects on Nanoparticles

NIES is constructing this building to provide new knowledge about the health effects of nanoparticle emitted from diesel–powered engines. The laboratory will be equipped with the newest exposure facilities for animal experiments, etc.

Rikubetsu Stratospheric Monitoring Station

NIES has been monitoring the stratospheric ozone layer over Hokkaido in collaboration with the Solar-Terrestrial Environment Laboratory (STEL) at Nagoya University. Monitoring is also performed in a room of the Rikubetsu Astronomical Observatory, which is run by the Rikubetsu town council. The center has been using various systems to monitor the vertical distribution of stratospheric ozone (by millimeter-wave radiometer); harmful ultraviolet rays (by Brewer spectrometer); and the vertical temperature distribution of stratospheric ozone (by laser radar). The aim is to reveal ozone depletion in the stratosphere and the effects of the Arctic ozone hole. Since parts of the polar vortex in the Arctic region sometimes arrive over Hokkaido in winter or spring, Rikubetsu is one of the sites used to study the effects of the Arctic polar vortex.

Soil Environment Laboratory

The soil laboratory contains unique small and large monolithic lysimeters, in which the behaviors of pollutants such as heavy metals and synthetic organic compounds, are investigated. The effects of pollutants on soil ecosystems (including the soil–organisms–plant system) are also investigated.

Tomakomai Flux Research Site

The main research objectives are to evaluate observation systems for measuring the fluxes of CO_2 and energy in a woodland ecosystem at Tomakomai National Forest in Hokkaido. This comprehensive research has continuously monitored a larch forest to elucidate carbon cycle functions such as CO_2 flux. The observations have been implemented with the cooperation of universities, national research institutes, regional government, and the Hokkaido Regional Forest Office as the main site. Unfortunately, the Tomakomai Flux Research Site was badly damaged by a typhoon on 18 September 2004. We are now discussing the use of an alternative site for continuation of our observations.

Vehicle Test Facility (VTF)

The VTF is equipped with an environment simulation room, an on-board measurement system, and a conventional exhaust measurement system, as well as devices originally developed by NIES, such as an exhaust gas dispersion chamber and a high-dilution-ratio tunnel, in order to measure and evaluate real-world vehicle exhaust.

Present Number of Personnel

President	1
Executive Director	2
Auditor	2
Research Coordinators	8
Audit Section	3
General Affairs Division	35
Executive Investigator	0
Principal Investigator	1
Social and Environmental Systems Division	19
Environmental Chemistry Division	14
Environmental Health Sciences Division	18
Atmospheric Environment Division	22
Water and Soil Environment Division	17
Environmental Biology Division	16
Climate Change Research Project	1
Ozone Layer Research Project	4
Endocrine Disrupters & Dioxin Research Project	15
Biodiversity Conservation Research Project	12
Watershed Environments and Management Research Project	9
PM2.5 & DEP Research Project	10
Research Center for Material Cycles and Waste Management	23
Research Center for Environmental Risk	8
Environmental Information Center	12
Laboratory of Intellectual Fundamentals for Environmental Studies	7
Center for Global Environmental Research	11
Total	270

Fields of Expertise

Basic Sciences	81
Engineering	66
Agricultural Sciences	22
Medical Science	18
Pharmacology	6
Fisheries Science	3
Economics	1
Jurisprudence	1
Total	198

Division Section/Team	Position	Staff Member
Headquarters	President	OHTSUKA, Ryutaro
	Executive Director (Research)	NISHIOKA, Shuzo
	Executive Director (Management)	IIJIMA, Takashi
	Auditor	KOIZUMI, Hideaki
	Auditor	SADAKUNI, Mamoru
Research Coordinators		
	Principal Research Coordinator	MATSUMURA, Takashi
	Deputy Director	UEHIRO, Takashi
Office of Research Coordination & Public Relations	Chief	NAKANO, Masahiro
	Research Coordinator	KINO, Nobuhiro
	Research Coordinator	TANABE, Masashi
	Research Coordinator	YAMAZAKI, Kunihiko
	Research Coordinator	HIROKANE, Katsunori
	Research Coordinator	SUGIYAMA, Kenichirou
	Research Coordinator (∗)	YAMAMOTO, Shoji
	Research Coordinator (∗)	UENO, Ryuhei
	Research Coordinator (∗)	TANABE, Kiyoshi
	Research Coordinator (∗)	OSAKO, Masahiro
Office of International Coordination	Chief (∗)	UEHIRO, Takashi
	International Coordination Researcher	
	International Research Coordinator (∗)	HIROKANE, Katsunori
Audit Section	Chief	ITO, Kishio
General Affairs Division	Director	KASHIWAGI, Jyunji
General Affairs Section	Chief	OTSUKA, Tetsuya
Accounting Section	Chief	KANAI, Nobuhisa
Facility Management Section	Chief	TAKEUCHI, Tadashi
Executive Investigator		
Principal Investigator		KABUTO, Michinori
Social and Environmental Systems Division		
	Director	HARASAWA, Hideo
	Deputy Director	
	Independent Senior Researcher	AOKI, Yoji
Environmental Economics Section	Leader	
		AOYAGI, Midori
		HIBIKI, Akira
		KAMEYAMA, Yasuko
		KUBOTA, Izumi
Resources Management Section	Leader (∗)	MORIGUCHI, Yuichi
		MORI, Yasufumi
		TERAZONO, Atsushi
Environmental Planning Section	Leader (∗)	HARASAWA, Hideo
		TAKAHASHI, Kiyoshi
		HIJIOKA, Yasuaki

(∗) Multiple roles

Information Processing and Analysis Section	Leader	YOKOTA, Tatsuya SUGA, Shinsuke SHIMIZU, Akira MATSUNAGA, Tsuneo YAMANO, Hiroya
Integrated Assessment Modeling Section	Leader	KAINUMA, Mikiko MASUI, Toshihiko FUJINO, Junichi HANAOKA, Tatsuya
Environmental Chemistry Division	Director Deputy Director Independent Senior Researcher	SHIBATA, Yasuyuki TANABE, Kiyoshi YOKOUCHI, Yoko
Analytical Instrumentation and Methodology Section	Leader (∗)	UEHIRO, Takashi KUME, Hiroshi ARAMAKI, Takafumi SHIRAI, Tomoko
Analytical Quality Assurance Section	Leader (∗)	TANABE, Kiyoshi ITO, Hiroyasu TAKAZAWA, Yoshikatsu
Environmental Chemodynamics Section	Leader	SEYAMA, Haruhiko KUNUGI, Masayuki TANAKA, Atsushi YONEDA, Minoru
Ecological Chemistry Section	Leader (∗)	SHIBATA, Yasuyuki EDMONDS, J. S. TATARAZAKO, Norihisa
Environmental Health Sciences Division	Director Deputy Director	TAKANO, Hirohisa KOBAYASHI, Takahiro
Molecular and Cellular Toxicology Section	Leader	NOHARA, Keiko OSAKO, Seiichiro ITO, Tomohiro YANAGISAWA, Rie
Environmental Biodefense Research Section	Leader	FUJIMAKI, Hidekazu MOCHITATE, Katsumi YAMAMOTO, Shoji KUROKAWA, Yoshika TSUKAHARA, Shinji
Biomarker and Health Indicator Section	Leader	HIRANO, Seishiro INOUE, Kenichiro SAI, Sei KOBAYASHI, Yayoi
Epidemiology and International Health Research Section	Leader	ONO, Masaji TAMURA, Kenji
Atmospheric Environment Division	Director Deputy Director	SASANO, Yasuhiro NAKANE, Hideaki

(∗) Multiple roles

Atmospheric Physics Section	Leader	EMORI, Seita
		SUGATA, Seiji
		NOZAWA, Toru
		HIGURASHI, Akiko
		OGURA, Tomoo
		NAGASHIMA, Tatsuya
Atmospheric Chemical Reaction Section	Leader	HATAKEYAMA, Shiro
		TAKAMI, Akinori
		SATO, Kei
		INOMATA, Satoshi
		TANIMOTO, Hiroshi
Atmospheric Remote Sensing Section	Leader	SUGIMOTO, Nobuo
		MATSUI, Ichiro
		SHIMIZU, Atsushi
		MORINO, Isamu
Atmospheric Measurement Section	Leader	TOHJIMA, Yasunori
		UTIYAMA, Masahiro
		MACHIDA, Toshinobu
		TAKAHASHI, Yoshiyuki
Acid Deposition Research Team	Leader	MURANO, Kentaro
	(*)	HATAKEYAMA, Shiro
	(*)	TAKAMATSU, Takejirou
	(*)	NOHARA, Seiichi
Water and Soil Environment Division	Director	KOHATA, Kunio
	Deputy Director	OTSUBO, Kuninori
Water Quality Science Section	Leader	FUJITA, Tsuyoshi
		TOMIOKA, Noriko
		SYUTSUBO, Kazuaki
		YAMAMURA, Shigeki
Soil Science Section	Leader	TAKAMATSU, Takejirou
		MUKAI, Satoshi
		HAYASHI, Seiji
		MURATA, Tomoyoshi
		KOSHIKAWA, Masami
Geotechnical Engineering Section	Leader	INABA, Kazuho
		DOI, Taeko
Lake Environment Section	Leader	IMAI, Akio
		MATSUSHIGE, Kazuo
		KOMATSU, Kazuhiro
Marine Environment Section	Leader	HARASHIMA, Akira
		NAKAMURA, Yasuo
Environmental Biology Division	Director	WATANABE, Makoto
	Deputy Director (*)	TSUBAKI, Yoshitaka
	Independent Senior Researcher	SHIMIZU, Hideyuki
Ecosystem Function Study Section	Leader	NOHARA, Seiichi
		MIYASHITA, Mamoru
		NATORI, Toshiki
		SATAKE, Kiyoshi
		YABE, Tohru

(*) Multiple roles

Biodiversity and Phylogenetic Study Section	Leader	KASAI, Fumie
		HIROKI, Mikiya
		UENO, Ryuhei
		KAWACHI, Masanobu
Tropical Ecology Section	Leader	OKUDA, Toshinori
		TANG, Yanhong
Molecular Ecotoxicology Section	Leader	SAJI, Hikaru
		KUBO, Akihiro
		AONO, Mitsuko
Climate Change Research Project	Director (∗)	INOUE, Gen
	Deputy Director (∗)	KAINUMA, Mikiko
	(∗)	MAKSYUTOV, Shamil
Carbon Cycle Research Team	Leader	NOJIRI, Yukihiro
	(∗)	TOHJIMA, Yasunori
	(∗)	MACHIDA, Toshinobu
	(∗)	TAKAHASHI, Yoshiyuki
	(∗)	MUKAI, Hitoshi
	(∗)	ARAMAKI, Takafumi
Carbon Sink Research Team	Leader (∗)	YAMAGATA, Yoshiki
	(∗)	FUJINUMA, Yasumi
	(∗)	OGUMA, Hiroyuki
Socio-economic & Emission Modeling Team	Leader (∗)	KAINUMA, Mikiko
	(∗)	HIBIKI, Akira
	(∗)	KAMEYAMA, Yasuko
	(∗)	MASUI, Toshihiko
	(∗)	FUJINO, Junichi
	(∗)	HANAOKA, Tatsuya
		KUBOTA, Izumi
Climate Modeling Team	Leader (∗)	EMORI, Seita
	(∗)	NOZAWA, Toru
	(∗)	HIGURASHI, Akiko
		OGURA, Tomoo
Impact & Adaptation Modeling Team	Leader (∗)	HARASAWA, Hideo
	(∗)	TAKAHASHI, Kiyoshi
	(∗)	HIJIOKA, Yasuaki
Ozone Layer Research Project	Director	IMAMURA, Takashi
Satellite Remote Sensing Research Team	Leader	NAKAJIMA, Hideaki
		SUGITA, Takafumi
	(∗)	YOKOTA, Tatsuya
Ground-based Remote Sensing Research Team	Leader (∗)	NAKANE, Hideaki
Ozone Layer Modeling Research Team	Leader (∗)	IMAMURA, Takashi
		AKIYOSHI, Hideharu
Endocrine Disrupters & Dioxin Research Project	Director	YONEMOTO, Junzo
	Deputy Director	SUZUKI, Noriyuki

(∗) Multiple roles

Chemical, Bioassay & Dynamics Research Team	Leader (∗)	SHIRAISHI, Fujio
	(∗)	TAKAGI, Hiroo
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ADEOS-II	Advanced Earth Observing Satellite II
ADI	Acceptable Daily Intakes
AGCM	Atmospheric General Circulation Model
AhR	Aryl hydrocarbon Receptor
AIM	Asia-Pacific Integrated Models
am-MeOx	amorphous Metal Oxides-bound
ASRs	Automobile Shredder Residues
BAL	Bronchoalveolar Lavage
BAL	Brorchial Alverolar Lavage
BFRs	Brominated Flame Retardants
BOD	Biochemical Oxygen Demand
BPA	Bisphenol A
BSO	Buthionine Sulfoximine
CALUX	Chemical Activated Luciferase Expression Assay
CAS	Chemical Abstracts Service
CB	Carbon Black
CHD	Catalytic Hydro-Dechlorination
CIRA	Committee on Space Research International Reference Atmosphere
CNC	Condensation Nucleus Counter
CODCr	Chemical Oxygen Demand as Determined by the Dichromate Method
Co-PCBs	Coplanar Polychlorinated Biphenyls
CTM	Chemical Transport Model
DE	Diesel Exhaust
DeBDE	Decabromodiphenylether
DEHP	Bis(2-Ethylhexyl) Phthalate
DEP	Diesel Exhaust Particles
DEP-OC	Organic Extract in DEP
DGGE	Denaturing Gradient Gel Electrophoresis
DMA	Dimethylarsinic Acid
DOM	Dissolved Organic Matter
EC	Elemental Carbon
ECOSAR	Ecological Structure-Activity Relationships
EDCs	Endocrine-Disrupting Chemicals
eNOS	endothelial Nitric Oxide Synthase
EnvMethod	Environmental Analytical Methods Database
ER	Estrogen Receptor
FISH	Fluorescence in Situ Hybridization
GC-ECD	Gas Chromatography-Electron Capture Detection
G-CIEMS	Grid-Catchment Integrated Modeling System
GC-MS	GC-Mass Spectrometry
GDP	Gross Domestic Products
GEMS/WATER	Global Environmental Monitoring System Freshwater Quality Program
GHG	Green House Gas
GIS	Geographical Information System
H_2O_2-Org	H_2O_2 extractable Organic-bound
HALOE	Halogen Occultation Experiment
HFC	Hydrofluorocarbon
IL	Interleukin
ILAS	Improved Limb Atmospheric Spectrometer
ILAS-II	Improved Limb Atmospheric Spectrometer II
IPCC	Intergovernmental Panel on Climate Change
ISO	International Standard Organization
JA	Jasmonic Acid
LAN	Local Area Network
LCA	Life Cycle Assessment
LC-MS	Liquid Chromatography/Mass Spectrometry
LC-TOFMS	Liquid Chromatography Time-of-Flight Mass Spectrometer
Lidar	Light Detection and Ranging
MAAs	Mycosporine-like Amino Acids
MeJA	Methyl Jasmonate
Me-Org	Metal-Organic Complex-Bound
MFA	Material Flow Accounting/Analysis
MMA	Monomethylarsonic Acid
MoBPCDDs/DFs	Monobromo Polychloro-Dibenzo-*p*-Dioxins/Dibenzofurans
MOE	Ministry of Environment
MPA	Marine Protected Area
MPAA	Phenylarsonic Acid
MRI	Magnetic Nesonance Imaging
MuSEM	Multimedia Simplebox-systems Environmental Model
NCEP	National Centers for Environmental Prediction
NDSC	Network for Detection of Stratospheric Change
NIST	the National Institute of Standards and Technology in the USA
NOEC	No Observed Effect Concentration
NOx	Nitrogen Oxide
OC	Organic Carbon
OECD	Organization for Economic Co-operation and Development
PBDD/DFs	Polybrominated Dibenzo-*p*-Dioxins/Dibenzofurans
PBDEs	Polybrominated Diphenyl Ethers
PCBs	Polychlorinated Biphenyls
PCD	Photochemical Dechlorination
PCDD/DFs	Poly Chlorinated Dibenzo-*p*-Dioxin/Dibenzofurans
PCR	Polymerase Chain Reaction
PET	Polyethylene Terephthalate
PIOT	Physical Input-Output Tables
$PM_{2.5}$	Particulate Matter less than 2.5 microns
PNDs	Postnatal Days
POAM	Poler Ozone and Aerosol Measurement
POP	Persistent Organic Pollutant
PRTR	Pollutant Release and Transfer Register
PSC	Polar Stratospheric Cloud
PTU	Propylthiouracil
QSAR	Quantitative Structure–Activity Relationship
RA	Retinoic Acid
RT-PCR	Reverse Transcriptase-Polymerase Chain Reaction
RXR	Retinoid X Receptor
SAGE II	Stratospheric Aerosol and Gas Experiment II
SDNN	Standard Deviation for Normal to Normal
SNP	Single Nucleotide Polymorphism
SPM	Suspended Particulate Matter
TBBP-A	Tetrabromobisphenol A
TBT	Tributyltin
TCDD	2,3,7,8-Tetrachlorodibenzo-*p*-Dioxin
TCE	Trichloroethylene
TeCB	Tetrachlorobenzene
TEOM	Tapered Element Oscillating Microbalance
TEQ	Toxic Equivalent Quantity
TG	Test Guideline

TMT	Trimethyltin
TOMS	Total Ozone Mapping Spectrometer
TR	Thyroid Hormone Receptor
TUNEL	TdT- mediated dUTP- biotin Nick End Labeling
UNEP	United Nations Envrionment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VDSI	Vas Deferens Sequence Index
VOC	Volatile Organic Compounds
WAN	Wide Area Network
WHO	World Health Organization
WNT	the Working Group of the National Coordinator of the Test Guidelines Programme
WWW	World Wide Web
XRE	Xenobiotic Response Element

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