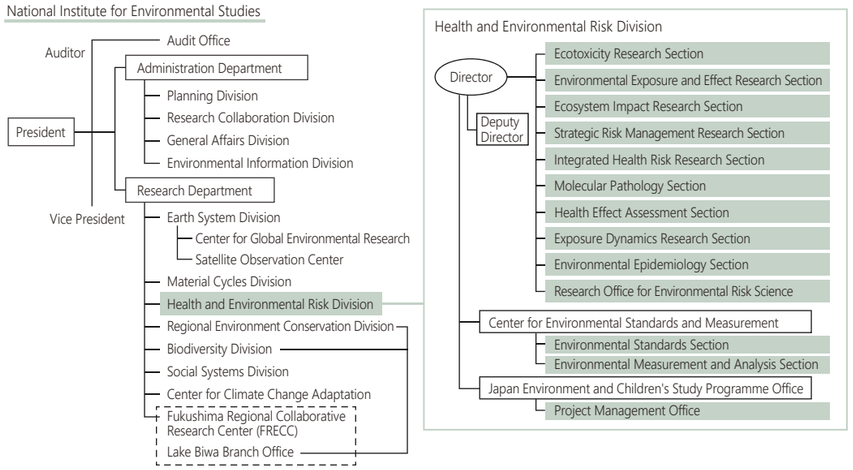
Health and Environmental Risk Division

Organization

The Health and Environmental Risk Division, one of six in the National Institute for Environmental Studies (NIES), promotes several researches to protect human health and preserve ecosystems from environmental hazards, such as chemical contaminants. The research includes the identification of hazardous factors; clarification of effect mechanisms, environmental fate, and exposure pathways; and development of testing, measurement, prediction, environmental risk assessment and management methodologies.



The Division comprises nine sections, the Research Office for Environmental Risk Science, one center and one program office. The sections are the Ecotoxicity Research Section, Environmental Exposure and Effect Research Section, Ecosystem Impact Research Section, Strategic Risk Management Research Section, Integrated Health Risk Research Section, Molecular Pathology Section, Health Effect Assessment Section, Exposure Dynamics Research Section, and Environmental Epidemiology Section. Each section promotes research ranging from basic science to project research such as strategic research programs. The Center for Environmental Standards and Measurement has two laboratories – an Environmental Standards Section and an Environmental Measurement and Analysis Section – which are responsible for fundamental work on environmental measurements, as well as for research and development. The Japan Environment and Children's Study (JECS) Programme Office manages and coordinates operations of this large-scale national project.

Research Facilities

Environmental Risk Research Laboratory

This is a comprehensive research facility that plays a central role in research and studies on environmental risks. It has experimental facilities for a freshwater environment, a seawater environment, and chemical analysis, and conducts research on ecological impact assessments, health impact assessments, and exposure assessments.

Micro-nanoparticle Research Laboratory

In the Micro-nanoparticle Research Laboratory we investigate the physical and chemical properties of anthropogenic aerosols, such as atmospherically-aged aerosols and microplastics, from ultrafine particles to micro-sized particles. We also use inhalation chambers and exposure in vitro to examine the health effects of particulate matter.

Animal Experimental Research Laboratory

To clarify the effects of environmental factors on human health, this research laboratory uses animal models and alternative methods, in compliance with ethical guidelines for the use of animals, to conduct studies on the health hazards of various environmental factors, including chemical contaminants.

Health and Environmental Risk Domain

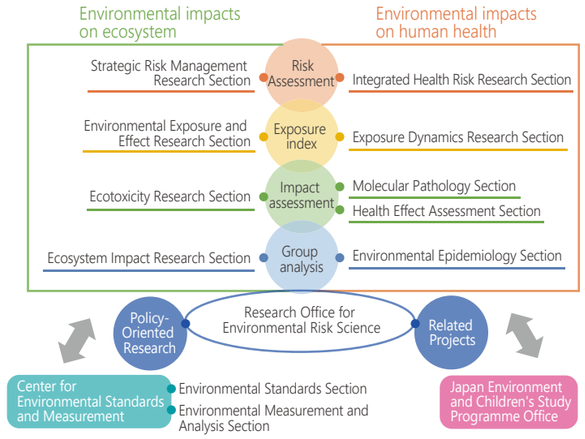
Research and studies for protecting human health and preserving ecosystems from harmful factors in the environment, such as deleterious chemical contaminants

Foresight and Advanced Basic Research

Policy-Oriented Research

Intellectual Research Infrastructure Development

In this domain, we promote foresight and advanced basic research and policy-oriented research to contribute to the protection of human health and the preservation of ecosystems from harmful environmental factors, such as chemical contaminants.



The foresight and advanced basic research includes the following: (1) evaluation of the toxic effects of a variety of chemicals on organisms in the environment, from the molecular level to the individual and population levels; (2) studies of exposure to chemicals in the environment, and advancement of methods for understanding and predicting actual states of exposure; (3) development of new methods to assess the impacts of ecosystem disturbance factors by using surveys, experiments, and model analysis; (4) systematization of chemical risk management and assessment of chemical kinetics and exposure; (5) development of methods for evaluating the health effects of microplastics and environmental pollutants such as PM2.5, and elucidation of the effect mechanisms; (6) new health impact assessment and mechanism elucidation considering multiple environmental factors, multiple diseases, and next-generation effects; (7) evaluation of biological effects on the cranial nervous system and elucidation of mechanisms; (8) development of a biomarker-based method for measuring lifetime exposure to pollutants; and (9) elucidation of the health effects of environmental pollutants and environmental factors by using epidemiological methods and statistical analysis methods for epidemiological studies as a basis for JECS.

In our policy-oriented research, we promote regulatory science research that is based on the latest scientific findings, including the results of our foresight and advanced basic research and our comprehensive environmental risk research program. We contribute to environmental policy through these results and promote our efforts as a reference laboratory.

Environmental Health Research Laboratory

The Environmental Health Research Laboratory includes a variety of facilities to evaluate pollution effects on community health through epidemiological studies on humans and experimental studies on animals to evaluate the effects of environmental pollutants.

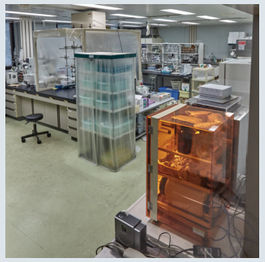
Aquatron

The Aquatron is a research laboratory consisting of thermostatic chambers, a continuous flow through system, and an aquarium to breed and culture various aquatic organisms such as fishes and crustaceans for use in ecotoxicity testing and to distribute to other research companies and institutes, universities, and schools.

Long-term Storage Facility of Environmental Samples and Genetic Resources

This Facility is for long-term storage of environmental samples. To develop an intellectual foundation for environmental research, it plays a role in long-term storage of biological samples, including cells of endangered wildlife, and environmental samples, such as atmospheric dust.

Fundamental Instruments for Measurement and Analysis/ Chemical Hazard Laboratories (Research buildings)



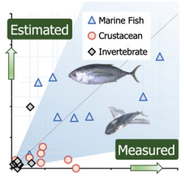
The Fundamental Instruments for Measurement and Analysis (FIMA) unit facilitates general analysis within the institute. Chemical hazard laboratories, which allow experiments with highly toxic chemicals, such as dioxins, to be safely used.

Sections and research office for basic and fundamental research

Environmental impacts on ecosystem

Risk assessment

Strategic Risk Management Research Section

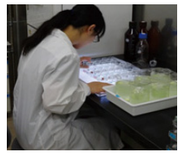


We help to systematically manage the risks to health and the environment by chemicals and other risk factors. The study topics include the occurrence and fate of chemicals, emission and exposure modeling, bioaccumulation, and the development and application of mathematical methods.

For example, we study biogeochemical cycles of global pollutants such as mercury (Hg) and estimate the Hg levels in seafood. We also collect and statistically analyze field data and develop mathematical models to study the effects of chemical substances on wildlife.

Impact assessment

Ecotoxicity Research Section

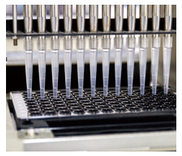


The Ecotoxicity Research Section is developing ecotoxicity test methods and models to assess the ecological impact of individual chemicals and mixtures by using techniques from molecular (e.g., genes and proteins) to organism levels (e.g., lethality, growth, and reproduction).

We use various organisms such as fishes and invertebrates to investigate the adverse effects of various chemicals, such as endocrine-disrupting chemicals, pesticides, pharmaceuticals, surfactants, metals and microplastics, and their mixture; effluents; and ambient water samples.

Exposure index

Environmental Exposure and Effect Research Section



The Environmental Exposure and Effect Research Section develops methods for understanding and predicting environmental exposure to and effects of chemical substances. To this end, we conduct research on environmental analysis of chemicals and air particles, total toxicity assessments by bioassays, and process and property evaluation for new environmental contaminants. Our research is driven by urgent social issues as well as medium- to long-term needs.

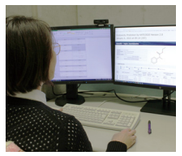
Group analysis

Ecosystem Impact Research Section

The Ecosystem Impact Research Section elucidates the present status of exposure to and adverse effects of environmental risk factors in coastal ecosystems, the analysis of modes of action (mechanisms), and proposals for countermeasures to restore the ecosystems. Environmental samples have been collected in the intertidal zone and coastal waters of Fukushima Prefecture as well as Tokyo Bay, and analyzed by chemical, biological and histological techniques. Exposure experiments are also conducted in the laboratory to identify causal factors.

Policy-oriented research

Research Office for Environmental Risk Science



The Research Office for Environmental Risk Science provides domestic leadership for the promotion of regulatory science based on current scientific findings. The Office also aims to implement environmental risk sciences into environmental policies in Japan through the development and dissemination of aquatic and avian ecotoxicological tests and the use of environmental risk assessments. The Research Office consists of two teams. The Environmental Risk Assessment Team conducts research on risk assessment methods, and also works with government agencies to support scientific environmental risk assessment based on environmental laws. The Ecotoxicity Reference Laboratory Team conducts research on ecotoxicity testing methods using aquatic organisms. This team also co-operates internationally to develop and standardize new testing methods.

Environmental impacts on human health

Risk assessment

Integrated Health Risk Research Section

Our research focuses on the development of methods for measuring the properties of atmospheric particulate matter of nanometer to micrometer sizes, such as microplastics and PM2.5, and the development of in vitro and in vivo systems to evaluate the impacts of atmospheric particulate matter on respiratory/cardiovascular organs on present and future generations. We have also focused on reproductive tissues, including germ cells, which atmospheric particulate matter directly or indirectly affect. We search for biological markers, such as the dynamics of germ cell organelles, by taking advantage of genetic engineering and microscopic technologies.

Impact assessment

Molecular Pathology Section

The Molecular Pathology Section provides scientific knowledge that contributes to health risk assessments by evaluating the effects of environmental factors such as chemical contaminants on the onset and progression of diseases and their molecular mechanisms.

We will evaluate the effects of environmental factors (chemicals derived from consumer products, air pollutants, etc.) on health and aging of the present and future generations, and elucidate the molecular mechanisms of these effects. We will analyze not only target organ toxicity but also interactions of biological systems (immune system, metabolic/endocrine system, brain and nervous system, etc.).

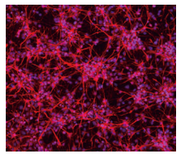
Exposure index

Exposure Dynamics Research Section

The research in this section focuses on measuring and estimating lifetime exposures to environmental stressors that may cause adverse health effects in humans. These environmental stressors include chemical substances, the physical environment, and diet, as well as socio-economic status and the built environment. The totality of the environmental exposure is called the exposome. The section is a leading research group on the exposome in Japan. Human biomonitoring and exposure modelling are key tools in this research. Imaging mass spectrometry is a flagship tool of this research section.

Impact assessment

Health Effect Assessment Section



We contribute to the prevention and reduction of adverse effects from environmental pollutants and other environmental factors on health by developing methods to evaluate their effects on the brain and nervous system, and other systems. We aim to develop a sensitive evaluation method by analyzing at various levels, including the molecular, cellular (embryonic stem cells, primary cell culture), tissue/individual, and behavioral levels, as well as by using fragile animal models.

Group analysis

Environmental Epidemiology Section

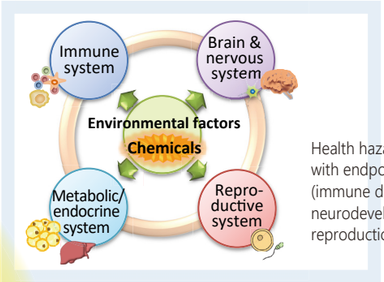
The Environmental Epidemiology Section conducts epidemiological surveys and other research to clarify the effects of environmental pollutants and environmental factors on health and provides knowledge that contributes to health impact assessments and health hazard prevention policies. We are also developing and upgrading epidemiological research methods. Specifically, in addition to promoting JECS, we are investigating the relationship between exposure to air pollution and health effects, the critical period of health-promoting factors in life-course epidemiology, and the interaction between humans and animals, and epidemiologically studying global health related to food and health in developing countries.

The above Sections in the Health and Environmental Risk Division promote basic and fundamental research and policy-oriented research to reduce the environmental risks to human health and ecosystems associated with harmful environmental factors such as chemical contaminants. We aim to contribute to the management of chemicals and environmental health policies through our policy-oriented research. Our basic and fundamental research includes the identification of toxic factors; their effects on sensitive biological receptors and health risks; chemical kinetics and exposure pathways; the development of testing, measurement and prediction methods; and environmental biophysical and epidemiological studies. In policy-oriented research, we promote regulatory science research based on the latest scientific findings, risk assessment projects, chemical substance database operations, and the distribution of experimental aquatic organisms.

Comprehensive Environmental Risk Research Program

Research Program on Comprehensive Assessment and Management of Human and Ecological Health Risk Caused by Chemicals and Other Pollutomes.

In this program, we are conducting research to promote the comprehensive risk assessment and management of chemicals and the total of all forms of pollution that can harm human and ecological health (i.e., the pollutome). To assess and manage the greater part of chemicals originating from human activities, we expanded the target chemicals to all chemicals of concern and considered vulnerable groups and life stages of humans and other organisms. In addition, we upgraded our comprehensive measurements and mathematical models to better assess those effects and risks that have been hard to quantify. As a result of these efforts, we are helping to establish comprehensive health risk indexes and ecological risk indexes.



Health hazard assessment of chemicals with endpoints of effects on health (immune diseases, metabolic diseases, neurodevelopmental disorders, etc.), reproduction, and future generations.

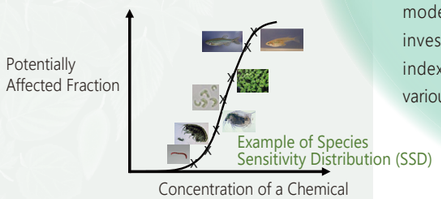
PJ1

Health Hazards Project

Health hazard assessment considering the real-life environment and vulnerabilities

The health effects of chemicals vary with exposure level and sensitivity, but their effects in the real world are not fully understood. The Health Hazards Project will conduct systematic research on the health effects of environmental factors, including chemicals, over the lifetimes of present and future generations. We will evaluate the health hazards, considering the real-life environment and vulnerabilities, find mechanism-based impact indicators, and propose new evaluation and prediction methods. These contributions will facilitate the development of comprehensive health risk indexes.

Environmental surveys along the coast of Fukushima Prefecture, Japan. Fisheries-independent bottom-trawl surveys and environmental monitoring since October 2012 include nine sites at 10-, 20-, and 30-m water depths. Spatiotemporal patterns in the megabenthic community along the Fukushima coast after the 2011 earthquake, tsunami, and nuclear disaster have been investigated.



Assessment of ecological impacts of a chemical on vulnerable species by investigating the species sensitivity distribution.

PJ2

Ecological Hazards Project

Ecological hazards and factor analysis considering vulnerabilities

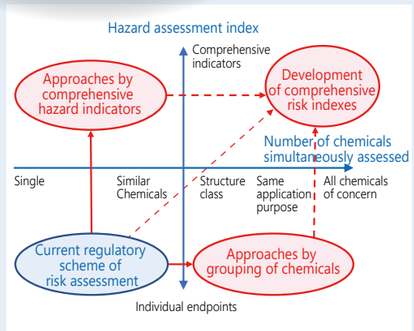
There have been many studies on the ecological impacts of chemicals and other pollution factors, but their causal analysis has been insufficient. To understand the factors that cause such impacts and evaluate control measures, we collaborate on field surveys of biota, laboratory experiments, and mathematical models. By focusing on vulnerable species and life stages, we investigate ecological hazards. Comprehensive ecological risk indexes are also developed to assess the combined effects of various factors.

PJ5

Comprehensive Risk Indexes Project

Development of comprehensive health risk and ecological risk indexes

This project proposes and develops comprehensive health risk and ecological risk indexes considering factors not currently involved in quantitative risk assessment schemes. The factors include toxic effects that are difficult to assess quantitatively, consideration of vulnerable populations, environmental fate of chemical mixtures and degraded products, and grouping of similar substances. Scientific information and findings from the four other PJ projects are being assembled, and comprehensive risk indexes will be proposed. The outcome of the project is contributing to both domestic and international environmental policies.



Conceptual diagram of comprehensive assessments of health and ecological risks.

PJ3

Pollutome Measurement Project

Comprehensive pollutome measurement

This project develops methods to measure and understand exposure to all environmental chemical substances of concern. We will also develop new methods of analyzing chemical substances that have been hard to identify and quantify, as well as establish a scheme that will facilitate identification of causative factors when new effects become apparent. To efficiently search for contributors to bioactivity, we will also develop selective collection materials and data analysis methods for substances that share common structures.

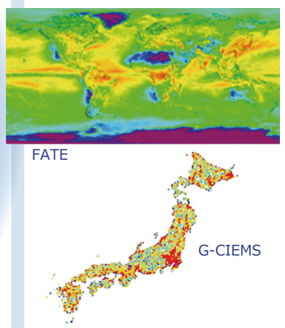
Triple quadrupole mass spectrometers, high-resolution mass spectrometers, microflow systems, etc. are used to develop comprehensive measurement methods for organic pollutants.

PJ4

Environmental Fate Project

Modeling the environmental fate of the pollutome

We are developing and improving methods to derive emission inventories, physicochemical parameters, bioaccumulation properties, and multimedia models to evaluate the environmental fate of all substances of concern for which we have only limited risk evaluation information; these methods will contribute to exposure assessments. These methods include a novel emission estimation method, focusing on substances categorized into the same usage, and bioaccumulation models applicable to polar and ionic organic substances.



Simulated concentrations of a pollutant in the atmosphere by a global environmental model FATE (upper map) and simulated concentrations of a pollutant in river water by a regional model G-CIEMS (lower map)

Center for Environmental Standards and Measurement

Research and development on environmental reference materials and on methods to improve the accuracy of chemical measurements

To understand the environment surrounding us, identify problems as quickly as possible, and respond appropriately, it is important to observe and measure the environment. It is also important to continue to observe and measure the environment to determine the progress of environmental problems and the effectiveness of countermeasures. The Center for Environmental Standards and Measurement provides high-quality technology and data for environmental measurement and contributes to solving environmental problems and improving the environment by ensuring its reliability as a national research institute. In order to maintain and improve measurement accuracy, we develop environmental reference materials and apply observation, measurement, and analysis methods. This center is also actively engaged in basic research to clarify phenomena and principles.

In this Center, the Environmental Standards Section and the Environmental Measurement and Analysis Section are responsible for fundamental measurement work in an inter-disciplinary manner, as well as advanced measurement research in cooperation with other fields. In addition to performing requested chemical analyses using instruments, the laboratory also prepares and provides environmental reference materials that meet international standards in response to social needs. We also add certified values and reference values to existing environmental reference materials to increase their utility. In addition, to understand the status of chemicals in the environment, we are also promoting a long-term preservation project for environmental samples, including collection, long-term preservation, and analysis of bivalve mollusks from the coast of Japan.

Storage of environmental samples in liquid nitrogen tanks

Environmental Reference Materials

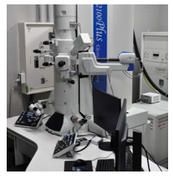
Environmental Standards Section

We are contributing to the realization of quality control by producing and distributing certified reference materials. Environmental samples are systematically collected, homogenized, and stored for long periods for future chemical analysis.

We present scientific methods and directions for monitoring environmental pollutants, which are regulated internationally in line with environmental policies. We are also developing and applying rapid sampling methods to estimate the effects of chemicals leaked during disasters.

Environmental Measurement

Environmental Measurement and Analysis Section



We believe that producing primary data through original experiments and observations is one of our advantages. We provide high-quality environmental measurement data and develop and apply observation, measurement, and analysis methods to maintain and improve measurement accuracy.

We are also actively engaged in innovative studies, such as measurement-based research to address future environmental issues and the development of advanced environmental measurement methods to facilitate scientific breakthroughs.

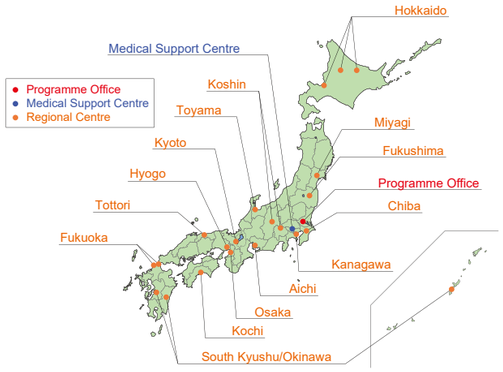
Japan Environment and Children's Study Programme Office

Provides core administrative and technical support for the conduct of the Japan Environment and Children's Study (JECS).

JECS is a nationwide birth cohort study funded by the Ministry of the Environment. It aims to identify environmental factors that affect the health and development of children. The Programme Office in NIES manages the study in collaboration with the National Center for Child Health and Development, which serves as the Medical Support Centre and provides the Programme Office with medical expertise, as well as with 15 Regional Centres based at universities and research institutes throughout Japan.

Recruitment of pregnant women to the study began in 2011; by the end of 2014, more than 100,000 mother–child pairs had been registered. The Regional Centres are responsible for collecting data, starting from pregnancy and following the children over the long term. In the main study, biannual questionnaires are used to collect information on the participants, such as their health and development, and the environmental factors to which they are exposed.
A sub-cohort study involves 5000 children randomly selected from the main cohort, and more in-depth measurement methods such as home visits, ambient air measurements, and psycho-developmental tests; pediatric examinations more thoroughly investigate the impact of environmental factors on outcome variables.

■ Study Locations ■



The Programme Office develops standard operation procedures, centralizes the data collected by the Regional Centres, administers the data management system, maintains the repository of biological and environmental samples, and performs exposure measurements; it is also responsible for risk management and participant retention. In addition, the Programme Office takes a leadership role in facilitating collaboration among the domestic and international research groups involved in the environmental birth-cohort study and provides a platform for the efficient exchange of information among the various research groups involved.

Storage of biospecimens collected as part of JECS.

Japan Environment and Children's Study
https://www.nies.go.jp/jecs/index.html
in Japanese

Databases and websites managed by Health and Environmental Risk Division

KAshinhou Tool for Ecotoxicity (KATE)

https://kate.nies.go.jp/index-e.html

Prediction tool of a chemical's aquatic toxicity to fish, daphnid, and algae

KATE is a web application tool that predicts ecotoxicity values to aquatic organisms (fish, water flea (*Daphnia magna*) and algae) according to "OECD Test Guidelines for Chemicals." The tool is based on quantitative structure-activity relationship (QSAR) models and predicts both acute and chronic ecotoxicity values.

Collection of reference materials for the establishment of Environmental Quality Standards

https://www.nies.go.jp/eqsbasis/index.html

What are the bases for establishing environmental quality standards in Japan?

The environmental quality standards (EQSs) for air, water, soil, and noise have been established and revised by the Ministry of the Environment, Government of Japan. This website collects references regarding the establishment and revision of EQSs and related items such as guideline values. The documents, references, and main texts on this website are written in Japanese, but summaries for each environmental medium will be translated into English.

Chemical Substance Database (Webkis-Plus)

https://www.nies.go.jp/kisplus/ (in Japanese)

Get comprehensive information on chemical substances by extensive search functions

Webkis-Plus is a website providing comprehensive information relating to environmental risk management. This site contains information on physicochemical properties; regulations (related mainly to environmental pollution); environmental concentrations from surveys; volumes of substances manufactured, imported, or both; volumes of agricultural chemicals shipped to each prefecture; Pollutant Release and Transfer Register (PRTR) emissions and transportation amounts; risk assessment results; and so on.

Grid-Catchment Integrated Environmental Modeling System (G-CIEMS)

https://www.nies.go.jp/rcer_expoass/gciems/gciems.html (in Japanese)

Simulates the environmental fate of contaminants throughout Japan

G-CIEMS is a spatially resolved and geo-referenced, dynamic, multimedia environmental fate model. This model predicts the concentrations of chemicals in the atmosphere, surface waters, surface water sediments, surface soils, coastal waters, and sewage collection areas based on environmental emissions and physicochemical properties of the target substances and use of geographical and meteorological information.

Simulation Models and Tools for Exposure Assessment

https://www.nies.go.jp/rcer_expoass/index.html (in Japanese)

Get models and tools for simulating environmental fates and visualizing geographic data

This website provides the following models and tools: G-CIEMS; the Multimedia Simplebox-systems Environmental Model (MuSEM), which is an integrated tool for assessing environmental risk; and a tool for visualizing geographic data containing simulation results obtained by G-CIEMS, and so on.

Tools for GC(×GC)-MS

https://www.nies.go.jp/risk_health/analysis/gcgcms.html (in Japanese & English)

A collection of programs designed for accurate mass spectrometry data analysis (for researchers)

This page provides original software to analyze data from a gas chromatograph-mass spectrometer (GC-MS) or a comprehensive two-dimensional gas chromatograph (GC×GC)-MS. A GC×GC is an instrument that can separate dozens of times more components than a conventional GC, allowing simultaneous separation of many kinds of chemicals. In addition, the high-resolution time-of-flight mass spectrometer (HRToFMS) is capable of extremely fast, accurate mass analysis. The combination of these instruments contributes to research on environmental pollution caused by a wide and complex variety of chemicals.

Tsukuba Air Quality Monitoring Data

https://www.nies.go.jp/aqrs/index.html (in Japanese)

Real-time PM2.5 and other air quality concentrations are reported.

As a part of quality control of the measurements, continuous air quality monitoring has been conducted at the Atmospheric Measurement and Experiment Laboratory (Air Quality Research Station) of NIES since 1978. The measurement results since 1995 are available on our website, and more detailed information and data can be provided upon request.

The fifth five-year plan (2021-2025)
Health and Environmental Risk Division 2022.12

National Institute for Environmental Studies
Health and Environmental Risk Division

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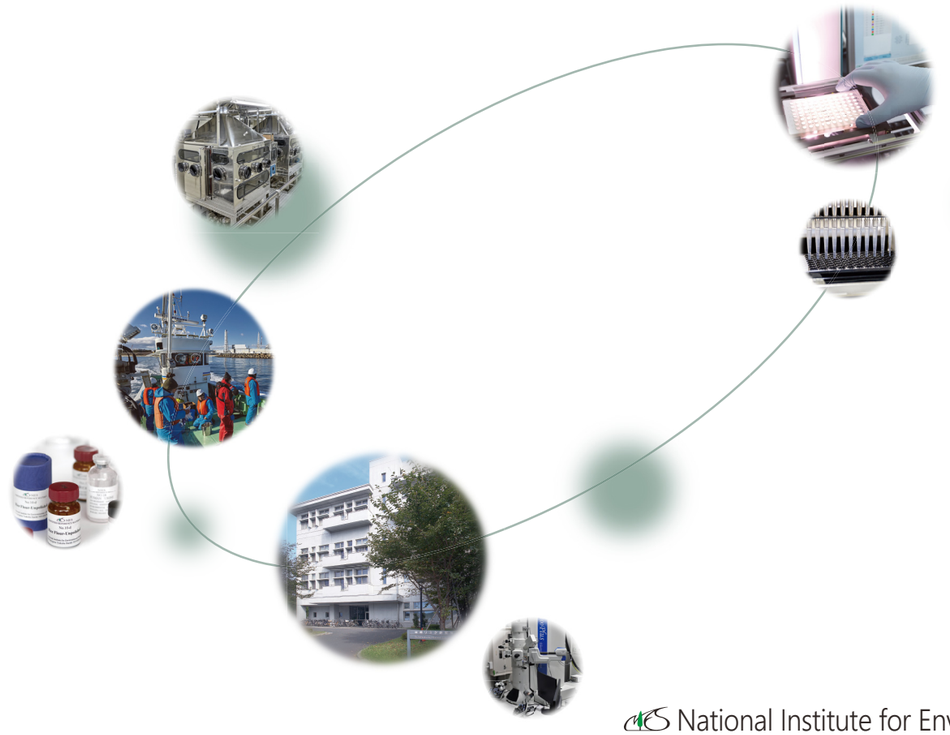
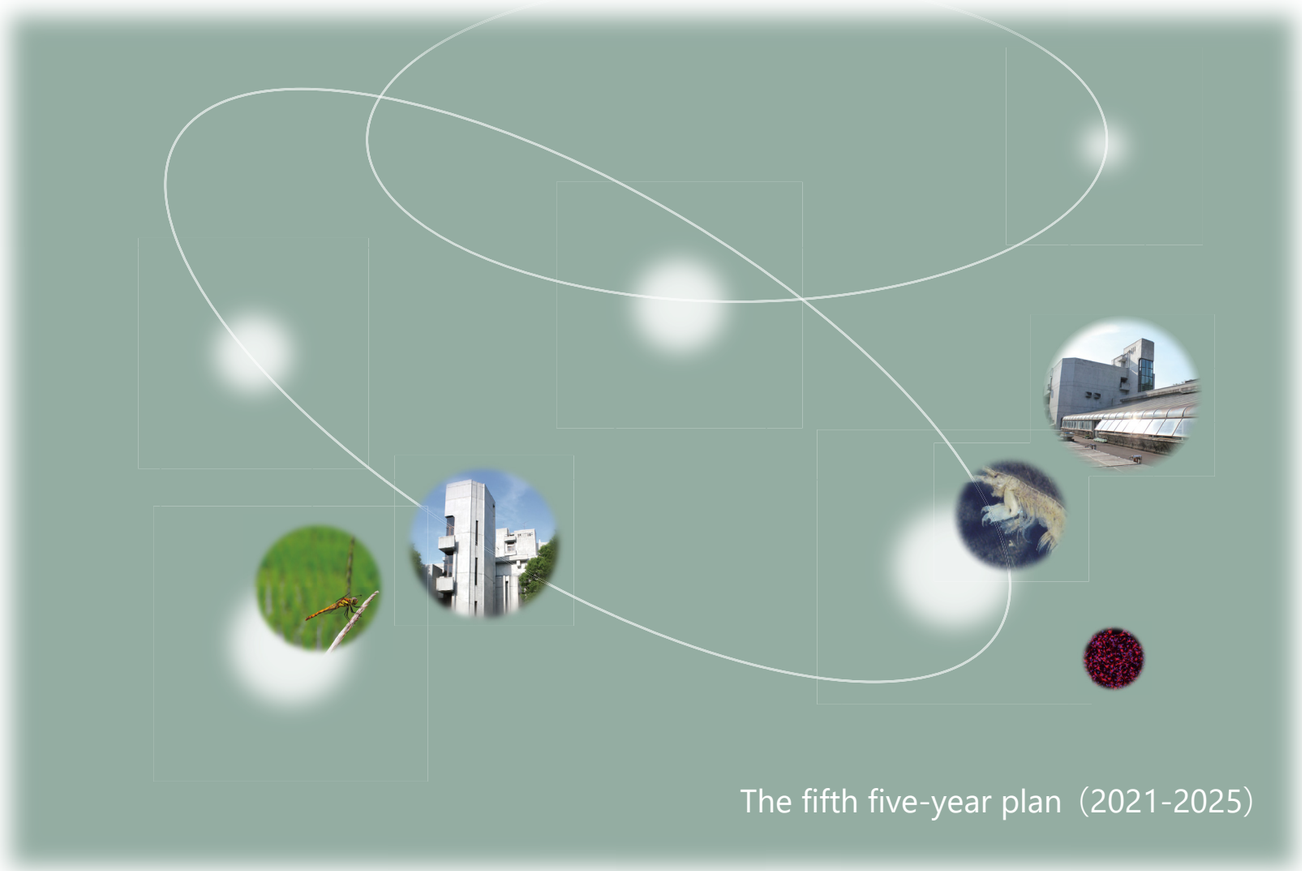


National Institute for Environmental Studies

Health and Environmental Risk Division



The fifth five-year plan (2021-2025)