

I Specific Study

1. Conservation of regional environments with respect to atmosphere, soil, geological layers, and the water cycle.

(1) Basic Study of Source Apportionment of Primary Emission and Secondary Formation of Fine Organic Particles (Atmospheric Environment Group: S. Hasegawa, S. Yonemochi, N. Umezawa, R. Matsumoto, and K. Sasaka/2011–2014)

The national environmental standard for PM_{2.5} was issued in 2009. The emission of PM_{2.5} and its precursors and secondary formation mechanisms have been identified as particular problems requiring investigation. In particular, organic components have various kinds of sources—primary emission when fossil fuels and biomass are burned, and secondary formation in the atmosphere. This study is measuring levoglucosan (an indicator of biomass burning) and water soluble organic carbon (an indicator of secondary formation). Methods for measurement and source apportionment are being examined to improve estimates of the contributions of primary emissions and secondary formation of fine organic particles.

(2) Evaluation of Air Pollution Events by Use of Full-year Observation Data of Fine Particulate Matters (Atmospheric Environment Group: S. Yonemochi, N. Umezawa, S. Hasegawa, R. Matsumoto, and K. Sasaka/2012–2014)

We previously carried out full-year observations with daily sampling of fine particulate matter (PM_{2.5}) based on the standard method used for monitoring PM_{2.5} mass concentration. We also carried out full-year observations with weekly sampling of PM_{2.5} and PM_{1.0}. In this study, we continue those observations and use them to evaluate various air pollution events such as high concentration episodes of suspended particulate matter (SPM) and PM_{2.5}, transboundary air pollution, and yellow sand events by use of samples and measurement data of fine particulate matter.

(3) Development of Measurement Techniques and Understanding of Current Conditions on Chemical Substances Derived from BVOCs by Photochemical Reactions in Saitama Prefecture (Atmospheric Environment Group: K. Sasaka, N. Umezawa, R. Matsumoto, S. Yonemochi, S. Hasegawa, Chemical Substances Group: K. Nojiri/2013–2015)

Air pollution due to fine particulate matter (PM_{2.5}) is a serious environmental problem. Various countermeasures have been taken by national and prefectural governments to lower emissions of volatile organic compounds (VOCs), which are one of the causative agents of PM_{2.5}. BVOCs (biological VOCs) are a class of VOCs that are emitted from organisms (*e.g.*, isoprene is emitted from terrestrial plants). However, little is known about the amount of emissions or the behavior of BVOCs and their contribution to PM_{2.5} formation. In this study we are developing an analytical technique for typical chemical products that are derived from BVOCs by photochemical reactions and attempting to better understand the present situation of the products in Saitama prefecture. These chemical products will be useful as molecular markers of PM_{2.5}. The ultimate aim of the study is to prepare countermeasures against PM_{2.5}.

(4) Investigation of the Current Situation of the Eutrophication Phenomenon in Rivers

and Evaluation of the Environmental Impact of Eutrophication (Water Environment Group: M. Takahashi, K. Ikeda, T. Kakimoto, and I. Mishima/2012–2014)

River environments have been improving steadily with advances in sewage treatment and other measures. However, pollution phenomena such as freshwater red tides (algal blooms) and foaming on the surface of rivers still occur, and are commonly caused by organic-matter laden runoff or effluent from areas of primary production. Such organic loads are a serious concern, and indicators of eutrophication therefore require careful monitoring. In this study, we are investigating the current extent and severity of eutrophication in rivers and stagnant water bodies and are evaluating the associated environmental impacts. We are also seeking the best methods for water sample pretreatment and analysis of total organic carbon through modifications to the measurement apparatus, especially for samples including suspended solids.

(5) Study on a Comprehensive Evaluation of Groundwater Quality in Saitama Prefecture and its Application to Administrative Management (Environmental Geotechnology Group: S. Hachinohe, T. Ishiyama, H. Hamamoto, and H. Shiraishi/2011–2014)

A groundwater quality survey found that water quality standards for regulated substances were exceeded in water samples from many wells throughout Saitama prefecture. However, the spatial extent of the polluted aquifer was not clear. In this study, we are analyzing groundwater quality for a range of parameters from samples collected from all parts of Saitama prefecture except mountainous areas. We are using these data to construct a GIS database. We expect that by providing a comprehensive evaluation method with this system, the means will be available to tackle groundwater quality contamination that requires administrative and regulatory solutions.

(6) Study on Atmospheric Weathering Processes of Sulfide Minerals in Marine Sediments and Investigation on the Risk Management for Soil Contamination (Environmental Geotechnology Group: T. Ishiyama, S. Hachinohe, H. Hamamoto, H. Shiraishi, Water and Geo-Environment division: S. Hosono/2012–2014)

When exposed to oxygen, marine sediments containing sulfide minerals (*e.g.*, Fe₂S) weather and become highly acidic, releasing various harmful heavy metals such as lead, cadmium, and arsenic into the environment. Techniques for immobilization of harmful heavy metals and weathering control by maintaining anaerobic conditions are recognized as useful methods for controlling this type of soil contamination. In this study, we are investigating the weathering processes of sulfide minerals and applying the results to risk management for hazardous marine sediments.

(7) Sequential Extraction Fractionation of Heavy Metals in Soil and Soil-to-Plant Transfer of Heavy Metals (Environmental Geotechnology Group: T. Ishiyama, S. Hachinohe, H. Hamamoto, H. Shiraishi, Water and Geo-Environment division: S. Hosono/2012–2014)

In Southeast Asia and China, the contamination of farmland by heavy metals is considered a major social problem; contamination is generally derived from irrigation water

polluted with industrial and domestic wastewater. Soil contamination greatly affects the safety of agricultural products produced on the farmlands. Heavy metals exist in the soil in various chemical forms; these include exchangeable states and reducible states. The degree of transfer of heavy metals from soil to agricultural products depends on such changes in state. In this study, we are applying a sequential chemical extraction method to soil and plant samples from contaminated farmland in China and are investigating the relationship between the amounts of heavy metals in each fraction and the soil-to-plant transfer efficiency.

2. Evaluation of the environmental risk from pollutants and countermeasures for risk mitigation in a regional area.

(1) Study on Potential Combustion-Origin Dioxins Transferring to Water Environment by Rainfall Runoff (Chemical Substances Group: K. Minomo, N. Ohtsuka, K. Nojiri, Atmospheric Environment Group: R. Matsumoto/2011–2013)

Ambient dioxin levels in the air in Saitama prefecture comply with the current Japanese environmental quality standard. However, dioxin concentrations in some river waters have continuously exceeded the environmental standard. This violation of the environmental standard is mainly attributed to dioxins of herbicide origin, but the impact of dioxins originating from combustion is not negligible. It has been suggested that dioxins originating from combustion are emitted from waste incinerators and then transferred to the land as dry and wet deposition from where they flow into rivers in rainwater runoff. The objective of this study is to elucidate the transport process of dioxins from air to river water.

(2) A Study on Contamination with Neonicotinoid Insecticides in River Water in Saitama Prefecture (Chemical Substances Group: N. Ohtsuka, M. Motegi, K. Nojiri, K. Minomo, and Y. Horii/2012–2013)

In recent years, neonicotinoid insecticides have been widely used in agriculture as an alternative to organophosphate insecticides. Neonicotinoid insecticides have attracted scientific attention because they have been implicated in honeybee colony collapse disorder. This study aims (1) to establish a method for analyzing neonicotinoid insecticides in environmental water samples, and (2) to measure contamination levels in river water in Saitama prefecture.

(3) Development for Analysis of Cyclic Volatile Methyl Siloxanes and Their Distribution in the Water Environment (Chemical Substances Group: Y. Horii, M. Motegi, N. Ohtsuka, K. Minomo, and K. Nojiri/2012–2014)

Cyclic volatile methyl siloxanes (cVMS) have been widely used in various industries because they have high thermal, electrical, and chemical stability and are believed to be inert. However, cVMS have recently been identified as priority chemicals for environmental risk assessment because of their persistence in the environment and bioaccumulative potency. In this research, we conduct a comprehensive study including development of a method for analyzing cVMS, investigation of emission sources, such as wastewater

treatment plants, and distribution of cVMS in the water environment in Saitama prefecture. This is the first study to analyze individual cVMS from the environment in Japan.

3. Construction of resource cycling and energy cycling systems based on prefectural characteristics

(1) Development of a Thermal Response Test Instrument and a Method to Evaluate Subsurface Thermal Environments for a Geothermal Heat Exchange System (Environmental Geotechnology Group: H. Hamamoto, S. Hachinohe, H. Shiraishi, T. Ishiyama, Environmental Radioactivity Monitoring Group: K. Satake/2012–2014)

Renewable energy resources play an important role in resolving both global warming and energy issues. Geothermal heat exchange systems have been used in Europe, the Americas, and China, but only tentatively in Saitama prefecture. One of the reasons for the limited uptake here is the lack of ability to predict the efficiency of a heat exchange system at a planned site. The thermal response (TR) test is extremely helpful to acquire such information. However, measurement instruments are not easily available in Japan because of the unavailability of ready-made instruments. In addition, the TR test is time consuming. In this study, we are developing a simple, easy-to-use measurement instrument and optimized method of TR testing.

4. Evaluation and conservation of biodiversity at regional scale

(1) Research on the Migration and Land-Lock of Diadromous Fishes in Saitama Prefecture (Natural Environment Group: H. Kanazawa, M. Miwa, K. Oh, and T. Yonekura/2011–2013)

Species of bony fish, jawless fishes, and crustaceans are known to migrate from Tokyo Bay to rivers in Saitama prefecture. However, the timing, extent, fish numbers and other characteristics of the migration are not clear. In this research, we investigated the migration of diadromous fishes by identifying the species and season of migration of migrating fishes to offer intelligible information to the inhabitants of Saitama prefecture. In addition, we investigated whether or not amphidromous fishes such as sweetfish and smelt are blocked from accessing the sea (i.e., landlocked by river structures) and interpreted this with regard to biodiversity conservation.

(2) Studies on a Technique for Reducing Plant Damage Caused by Photochemical Oxidants (Natural Environment Group: M. Miwa, K. Oh, T. Yonekura, and H. Kanazawa/2011–2013)

In Saitama prefecture, concentrations of photochemical oxidants in the summer have been remarkably high. The damage caused to plants by ozone, which is the dominant component of photochemical oxidants, can be observed in the field. Under these circumstances, we developed a technique for reducing plant damage caused by ozone based on the results of ozone exposure experiments, and aim to propose the technique for public use.

(3) Research on an Evaluation Method for Aquatic Habitats in Small Rivers and Irrigation Channels (Water Environment Group: Y. Kimochi, H. Tanaka, Natural Environment Group: H. Kanazawa/2013–2014)

Habitats for aquatic organisms have deteriorated in Saitama prefecture. However, little research has been done on the relationship between aquatic organism abundance and habitat. In this research, we are conducting field observations of river environment, water quality, and the biomass of various aquatic organisms, and examining the aquatic habitats of these organisms, mainly in irrigation channels in Kumagaya City. The data are arranged in the form of "Karte: clinical records" before analysis. We also intend to use existing methods for habitat evaluation and aim to construct practical and useful methods based on field data.

5. The current state of global warming, its effects on the environment, and application of countermeasures in Saitama prefecture.

(1) Evaluation of N₂O Production Potential in Wastewater Treatment Processes (Water Environment Group: I. Mishima/2012–2014)

The reduction of emissions of greenhouse gases such as N₂O and CO₂ from wastewater treatment processes can contribute to the mitigation of global warming. N₂O is produced during biological nitrification and de-nitrification processes, and CO₂ is generated by electric power consumption for aeration in the treatment process. Our previous studies showed that controlling the NO₂ concentration changed the N₂O production rate. The objective of this study is to evaluate the N₂O production potential by observing the relation between N₂O and NO₂ behaviors.

(2) Development of a Thermal Response Test Instrument and a Method to Evaluate Subsurface Thermal Environments for a Geothermal Exchanger System (details given above under Research Theme 3)

II Basic Research

- **Solutions for important problems in environmental conservation**
- **Technological developments in analytical measurements**
- **Construction of an environmental database**

(1) Construction and Operation of a Database on the Natural Environment by Applying a Geographical Information System—Research on the transition of forest and its functions (Global Warming Countermeasures Group: T. Shimada, Y. Masutomi, Natural Environment Group: M. Miwa/2013–2015)

A database of the natural environment in Saitama prefecture has been constructed by using a geographical information system (GIS). We are conducting a detailed analysis of the transition in forest using the database to evaluate the potential for forestland in the prefecture to contribute to global warming mitigation.

(2) Assessment of Variations in Efficiency among Varieties of Resource Plants for Phytoremediation of Contaminated Soils (Natural Environment Group: K. Oh, M. Miwa, T. Yonekura, H. Kanazawa, Atmospheric Environment Group: S. Yonemochi, Material Cycles and Waste Management Group: Y. Isobe, Water and Geo-Environment Division: S. Hosono/2013-2016)

Soil contamination with heavy metals and other harmful substances is a worldwide environmental concern. Phytoremediation is the use of green plants and their associated microbiota for the in situ treatment of contaminated soils; it has received increasing attention as a cost-effective and eco-friendly technology.

Conventional phytoremediation methods use purpose-bred plants that have high capacity for the accumulation of contaminants, but they are expensive to use. We are focusing on the development of more cost-efficient soil phytoremediation through the application of crops that can be used for biofuel or other economic uses instead of the purpose-bred plant varieties. Such crop plants can generate resources at the same time as they effect phytoremediation of contaminated soils. We found that some biofuel crops such as maize and sunflower, because of their large biomass production, had similar or greater phytoremediation potential for heavy metals than purpose-bred plants. However, little information is available on the differences in phytoremediation efficiency among varieties of resource crops. The objectives of this study are to assess the differences in efficiency among varieties of resource plants and to select the crop varieties that are most suitable for soil phytoremediation.