Research Themes in the Fiscal Year 2017

Center for Environmental Science in Saitama (CESS)

I. Policy Research

1. Supporting new energy sources for creating a low-carbon society and mitigating climate change

(1)Estimation and analysis of high-resolution anthropogenic heat inventory in Saitama Prefecture (Global Warming Strategy Group: M. Hara, Research, Y. Muto, K. Honjo, Promotion OfficeT. Shimada 2017–2019)

High-resolution anthropogenic heat inventory is essential to accurately simulate regional climate including urban heat island phenomena. The anthropogenic heat inventory can be used for estimating amount of energy consumption in Saitama Prefecture. Especially, decadal change of anthropogenic heat inventory with high temporal and spatial resolved is not estimated by any other institution. In this study, we estimate the decadal change of high-resolution anthropogenic heat inventory to analyze heat budget in Saitama Prefecture.

(2) Statistical modeling of household GHG emissions in Saitama Prefecture (Global Warming Strategy Group: K. Honjo, Y. Muto, M. Hara, Research Promotion officeT. Shimada; 2017–2019)

Household GHG emissions in Saitama Prefecture have continued to increase since 1990, and the emissions in 2014 exceeded the level in 2005 (the base year for the prefecture) by 26%. The prefectural government needs to strengthen climate change policies such as energy conservation in housings, with attention to Japan's NDC (Nationally Determined Contribution). In this study, we develop a time series model of energy demand and GHG emissions in the household sector, and provide fundamental information supporting policymakers. Specifically, we quantitatively evaluate the impacts of demographic, economic, and meteorological changes on households' energy consumption behavior. Using the evaluation results, we can improve the accuracy of GHG emissions estimates for cities and towns in Saitama Prefecture. Furthermore, we input socioeconomic scenarios into the model, and forecast GHG emissions until 2030. The GHG forecast is expected to play the important role in determining a long-term emissions reduction target for Saitama Prefecture. Statistical modeling of household GHG emissions in Saitama Prefecture

(3) Impact on Natural Environment and Regional Society from Geothermal Heat Exchange Systems (Environmental Geotechnology Group: H. Hamamoto, S. Hachinohe, T.Ishiyama;T.kakimoto;PromotionnnOffice:H.Shiraishi;T.Shimada; Global Warming Strategy Group: M. Hara, K. Honjo,; Chemical Substance and Evnvironmental Radioactivity Group: T. Yamazaki / 2015–2017)

Renewable energy is an important element in solving global warming and/or energy problems. Geothermal heat exchange systems are a useful type of renewable energy. Accordingly, we have developed a new method of estimating and mapping heat potential for geothermal heat exchanger systems and have mapped heat potential in the Saitama area. It is also important to evaluate the influence of such systems on the natural environment and regional society when such systems become widely adopted. In this research, we are evaluating the effects of such systems on the reduction of CO2 emissions based on social statistical data and results of

demonstration experiments. Furthermore, we are evaluating the influence of such systems on the subsurface microbial environment and heat interference.

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2. Controlling waste generation and building resource recycling systems for creating a sound material cycle society

(1) Estimation of Solid Waste Stabilization in Landfills in a Recycling-based Society (Material Cycles and Waste Management Group: Y. Isobe, M. Nagamori, M. Kawasaki, T. Hase, K. Suzuki,Research Promotion Office: Y. Watanabe / 2015–2017)

The lifetimes of landfills in Japan are increasing because of the decreasing amounts of municipal solid waste (MSW) and increasing rates of MSW recycling in recent years. Landfills in Saitama Prefecture also show these typical trends: a decrease in the annual waste amount, and an increase in the ratio of landfilled noncombustible waste because some cement plants use MSW incineration ash as a raw material in cement production. Because landfill management requires a long period and involves huge costs, it is necessary (1) to predict changes in the quantity and quality of waste in the near future, (2) to understand the processes of waste stabilization, and (3) to estimate the period required for waste stabilization. In this study, we will design and implement a pilot-scale testing area in a landfill and measure several chemical substances leached and emitted from the waste to estimate solid waste stabilization in a landfill

(2) Land displacement monitoring in Saitama Prefecture supported by remote sensing (Environmental Geotechnology Group: S. Hachinohe; Environmental Geotechnology Group: H. Hamamoto, T. Ishiyama,T.kakimoto; Research Promotion Office: H. Shiraishi; Global Warming Countermeasures Group: M. Hara; Water Environment Group: T. Kakimoto; 2016–2018)

Land subsidence damage in Saitama Prefecture is still ongoing, especially in dry years, although the seriousness of the damage is decreasing result of pumping regulation policy from 1960s. Furthermore, because this prefecture is located in the center of the largest alluvial plain in Japan and is undergoing continued urban development, the extent of urban land vulnerable to flooding is increasing. In this research, we are evaluating and optimizing a procedure for monitoring land displacement by using synthetic aperture radar onboard satellites. We will use the procedure to analyze the regional characteristics of land subsidence problems in Saitama Prefecture.

3. Protecting rivers, forests and biodiversity to create a society in harmony with nature

(1) Fundamental Research on Conservation of Endangered Animals and Plants in Saitama (Natural Environment Group: M. Miwa, H. Tsunoda, T. Yonekura, K. Oh, H. Kanazawa, Promotion Office : T. Shimada / 2015–2017)

In this research, we are collecting data on the endangered animals and plants listed in the Saitama Red Data Book. This includes information on their distribution, information on the literature concerning them and information on activities aimed at their conservation. Also, with respect to endangered species designated for conservation by ordinance of Saitama Prefecture, we are investigating the environment of their habitat and their life history. We aim to unify this

information and data from the investigation into a database and make the database available to be used for consultation about endangered species and activities aimed at their conservation in Saitama.

(2) Evaluating the impacts of sika-deer browsing on shrub-layer vegetation and the use of deer hunting to restore shrub species
(Natural Environment Group: H. Tsunoda, M. Miwa, T. Yonekura, K. Oh; Promotion Office T. Shimada; 2016–2018)

The abundance of sika deer (Cervus nippon) has increased in western Saitama Prefecture, and a decline in vegetation cover has been observed as a result of intensive browsing by overabundant deer populations. In this research, we are surveying the temporal patterns of decline of shrub-layer vegetation and indicator of deer abundance to determine the current status of the impact of deer browsing on vegetation cover. Furthermore, we are comparing the occurrence and behaviors of deer, and the proportions of shrub species browsed by the deer, between areas inside a hunting area and outside a deer-exclusion fence to assess the effects of hunting on shrub species restoration.

(3) Application of Water Quality Simulation Model to Eutrophic Rivers, and Proposal for River Water Quality Management Measures (Water Environment Group: T. Kakimoto, K. Ikeda, I. Mishima, K. Watanabe / 2015–2017)

The concentration of chlorophyll a, an index of algal blooms, in the rivers of Saitama Prefecture is relatively high; high concentrations are observed, especially in the eastern and southern areas of the prefecture, where concentrations reach a level equal to those of eutrophic lakes. High concentrations of algae in waterbodies result in deterioration of transparency, pollution by excessive organic matter, and bad odors, and also cause large diurnal changes in pH and dissolved oxygen as a result of algal photosynthesis and respiration. It is well known that a reduction in nutrients (e.g., Nitrogen and Phosphorus, nutrients essential for algal growth) is necessary to improve the water quality of rivers suffering from high algal concentrations. However, there is little information about the desired levels of nutrients sufficient to control abnormal algal growth. In these circumstances, we have developed a mathematical ecosystem model that represents algal growth as a function of nutrient concentrations and simulates the behavior of organic matter originating from algae. Because the interactions among concentrations of nutrients, algae, and organic matter depend on the characteristics of the waterbody under examination, we describe these components and interactions quantitatively in the ecosystem model. We intend to use the developed model to propose methods of preventing the water quality of rivers from deteriorating due to eutrophication.

(4) Applicability of fluorescence PARAFAC-EEM to river water quality monitoring (Water Environment Group: K. Ikeda, T. Kakimoto, I. Mishima, K. Watanabe; 2016–2018)

Parallel factor analysis with excitation emission matrix fluorescence (PARAFAC-EEM) is a novel and powerful form of spectrofluorometry for separating out, detecting, and quantifying aquatic organic matter. Application of this method to river water quality monitoring could make it possible to detect the components that strongly influence river water quality and to thus

evaluate quality. PARAFAC-EEM could help in water quality management through real-time detection of quality deterioration and clarification of the causes. However, there have been few reports of the use of this method in the long-term monitoring of river contamination by domestic waste water. In this fundamental study, a technique for applying PARAFAC-EEM will be developed by using fluorescence data from the river waters of Saitama Prefecture. The behaviors of fluorescent components will then be determined and the corresponding organic matter will be characterized.

A water quality evaluation model will be constructed by performing a correlational analysis between the intensity of fluorescent components and water quality indexes such as BOD . Finally, a method of assessing the origin of the contaminants will be developed by collecting fluorescence data as a kind of fingerprint of the source of pollution.

(5)Number of Escherichia coli cells in waterfront spaces in Saitama Prefecture. (Water Environment Group: K. Watanabe, K. Ikeda, I. Mishima, Environmental Geotechnology Group: T. Kakimoto, /2017-2019)

In aquatic environments, pathogenic microbes are a potential source of infection through exposure to human skin. Therefore, management of the risk posed by pathogenic microbes is very important. In aquatic environments, the main source of infection by pathogenic microbes is the presence of human or cattle excrement. To date, coliform group have been used an index of fecal pollution, but this index includes bacteria that are not related to fecal pollution and occur naturally in soil and water. Our goal in the near future is to shift away from the use of the number of coliform group and toward the number of Escherichia coli, which is more direct index of fecal pollution. In this study, we study actual bacterial conditions and investigate a methodology for the use of the new index in waterfront spaces in Saitama Prefecture.

4. Promoting disaster countermeasures and protecting air, water and soil environments to create an environmentally sustainable society

(1) Study on metal element in PM2.5 and PM1 samples of long-term observation (Atmospheric Environment Group: S. Yonemochi, K. Sasaka, S. Hasegawa, K. Nojiri, Y. Fujii,Research Promotion Office: R. Matsumoto, Water Environment Group:N. Umezawa, ／2015-2017)

Many people and the mass media have become interested in air pollution caused by fine particulate matter (PM2.5), especially transboundary air pollution, since the serious PM2.5 pollution that occurred in China in January 2013.

We have observed PM2.5 daily since 2000 with the standard method defined by Ministry of the Environment, and we have also conducted weekly observations of PM2.5 and PM1. Chemical analysis of these PM samples show that elemental metals provide information on the long-range transportation of PM.

In this study, we are continuing these observations of PM, focusing on metal elements, to elucidate the causes of various air pollution events, such as episodes of high PM2.5 concentration, in connection with transboundary air pollution.

(2) Study on Source Apportionment of PM2.5 Caused by Local- and Regional-Scale

Pollution (Atmospheric Environment Group: S. Hasegawa, S. Yonemochi, N. Umezawa, R. Matsumoto, K. Sasaka, K. Nojiri, Y. Fujii / 2015–2018)

The rate of achieving environmental quality standards for PM2.5 is still low. The increase in PM2.5 concentration in Japan is caused not only by long-range transport of pollutants from distant areas but is also caused by local- and regional-scale pollution. Episodes of high PM2.5 concentrations have often been observed only in the Kanto region; this is the central region of Japan, and includes Saitama as a constituent prefecture. This fact suggests that the influence of local- and regional-scale pollution is larger in the Kanto region than in other regions. We aim to clarify the contributions of local- and regional-scale pollution in order to take effective countermeasures against emission sources.

In this study, chemical compositions of PM2.5 will be observed, and the available PM2.5 monitoring data and chemical compositions of ambient PM2.5 and PM2.5 sampled from exhaust streams will be utilized for the data analyses. The observations and data analyses will be carried out in cooperation with other local governments in the Kanto region, and nationwide through various collaborative studies. One of our major targets is to estimate the contribution of local- and regional-scale pollution to obtain a plausible inventory of emission sources.

(3) Background levels and geographic distribution of heavy metals in natural soils in Saitama Prefecture (Environmental Geotechnology Group: T. Ishiyama, S. Hachinohe, H. Hamamoto,T.kakkimoto; 2016–2018)

Recently, naturally derived soil contamination with heavy metals such as lead, arsenic, and fluorine has been reported in various part of Japan, including Saitama Prefecture. For adequate evaluation of soil contamination derived from natural processes it is very important to analyze the background levels and geographical distributions of heavy metals in natural soils. In this study, we are testing the background levels and leaching of heavy metals in natural soils in Saitama Prefecture and examining the geographical distributions of these heavy metals.

(4) Risk assessment for ozone by using stomatal flux-based critical levels for effects of ozone on yield of Japanese rice cultivars grown in Saitama Prefecture. (Natural Environment Group: T. Yonekura, K. Oh, H. Tsunoda, H. Kanazawa, M. Miwa, Saitama Agricultural Technology Research Center: M. Arakawa, J. Munakata/2017-2019)

Tropospheric ozone is one of the most phytotoxic air pollutants. Current ozone concentrations in Saitama have been shown to decrease the production of agricultural crops. We have a little information regarding the effects of elevated ozone concentration on yield of important agricultural crops such as Japanese rice in Japan. Therefore, to assess the potential risk of ozone on rice production by using the concepts for crop critical levels, we investigated relationship between the flux of ozone through the stomata and yield responses to ozone of rice cultivars grown in Saitama Prefecture in Japan.

(5) Survey of environmental contamination by organohalogen flame retardants in Saitama Prefecture (Chemical Substance and Environmental Radioactivity Group: M. Motegi, K. Minomo, N. Ohtsuka, Y. Horii, S. Takemine, Atmospheric Environment Group: K. Nojiri/2014–2017)

Hexabromocyclododecane (HBCD) is an organobromine flame retardant used for residential insulation and textile products. HBCD was listed as a persistent organic pollutant (POP) by the

Stockholm Convention in 2013, and its import and production have been banned in Japan since 2014. Dechlorane plus (DP), an organochlorine flame retardant that is added to coating resins of electrical wires and cables, is still marketed. However, DP has recently attracted much attention as an environmental pollutant; it may become a candidate for evaluation as a POP by the convention in the future. Although the environmental persistence and bioaccumulation characteristics of these two flame retardants have been recognized, official analytical methods have yet to be established. In this study, to elucidate their environmental behavior, we survey contamination levels of these flame retardants in ambient air, river water, and riverbed sediment in Saitama Prefecture. This study will provide useful information for environmental mitigation of flame retardant contamination.

(6) Occurrence of volatile methylsiloxanes in the atmospheric environment (Chemical Substance and Environmental Radioactivity Group: Y. Horii, K. Minomo, N. Ohtsuka, M. Motegi, S. Takemine, Atmospheric Environment Group: K. Nojiri/2015-2017)

Some volatile methylsiloxanes (VMS) have recently been identified as priority chemicals for environmental risk assessment due to their persistence in the environment and bioaccumulative potency. The information of VMS in the atmospheric environment as a major compartment existing VMS is essential to reveal their environmental processes, fate and evaluation of their potential risk. However, the information concerning concentration

(7) Development of methods for rapid analysis of hazardous chemical substances in the atmosphere and evaluation the risks posed by such substances in emergencies (Chemical Substance and Environmental Radioactivity Group: M. Motegi, N. Ohtsuka, K. Minomo, Y. Horii, S. Takemine; Atmospheric Environment Group: K. Nojiri; 2016–2019)

The release of large amounts of the hazardous chemical substances (HCSs) used in factories to the environment through accidents or disasters raises serious concerns about the effects of these substances on ecosystems and human health. The implementation of two regulations, the Pollutant Release and Transfer Register Law and Saitama Prefecture's Ordinance to Preserve the Living Environment, has made it possible to determine the amounts HCSs handled in factories over the past decade or so and the amounts released and transferred to the other places. Although there is a risk that HCSs might be discharged to the environment in emergency situations, standard analytical procedures and risk assessments have not yet been established for some HCSs in japan. In this study, we are developing procedures for the rapid analysis of high-risk HCSs (selected on the basis of information on their toxicity and amounts handled). We then intend to survey HCS levels in the atmosphere around factories under non-emergency conditions. We will also create a manual of procedures for assessing the risks posed by HCSs.

(8) Study on the environmental behavior of radioactive materials in an ecological garden (Chemical Substance and Environmental Radioactivity Group:T. Yamazaki, M. Motegi,T.Ito, Atmospheric Environment Group: S. Yonemochi, : Research Promotion officeT.T. Shimada, Natural Environment Group: M. Miwa, Research Promotion Office: H. Shiraishi, N. Umezawa /2014-2017)

Radioactive materials released into the atmosphere by the accident at the Fukushima Daiichi Nuclear Power Station in March 2011 have since been transported by advection and diffusion

to the Kanto Plain, where they have been deposited as fallout. Radioactive cesium in particular has reached a high concentration in some areas of the plain. Cesium in fallout is distributed, transported, and accumulated in various environmental substances. Therefore, the transport characteristics of cesium need to be evaluated. An ecological garden has been constructed at our research center in Kazo City as a model of a relatively closed ecosystem environment. In this study, we investigate concentrations of radioactive materials, especially radioactive cesium, in the soil, water, and biota of the ecological garden to clarify their environmental behavior

II. Basic Research

- **Investigating issues vital to environmental protection other than the issues covered by Policy Research**
- **Developing/acquiring technology for advanced measurement and analysis**
- **Building environmental information databases**

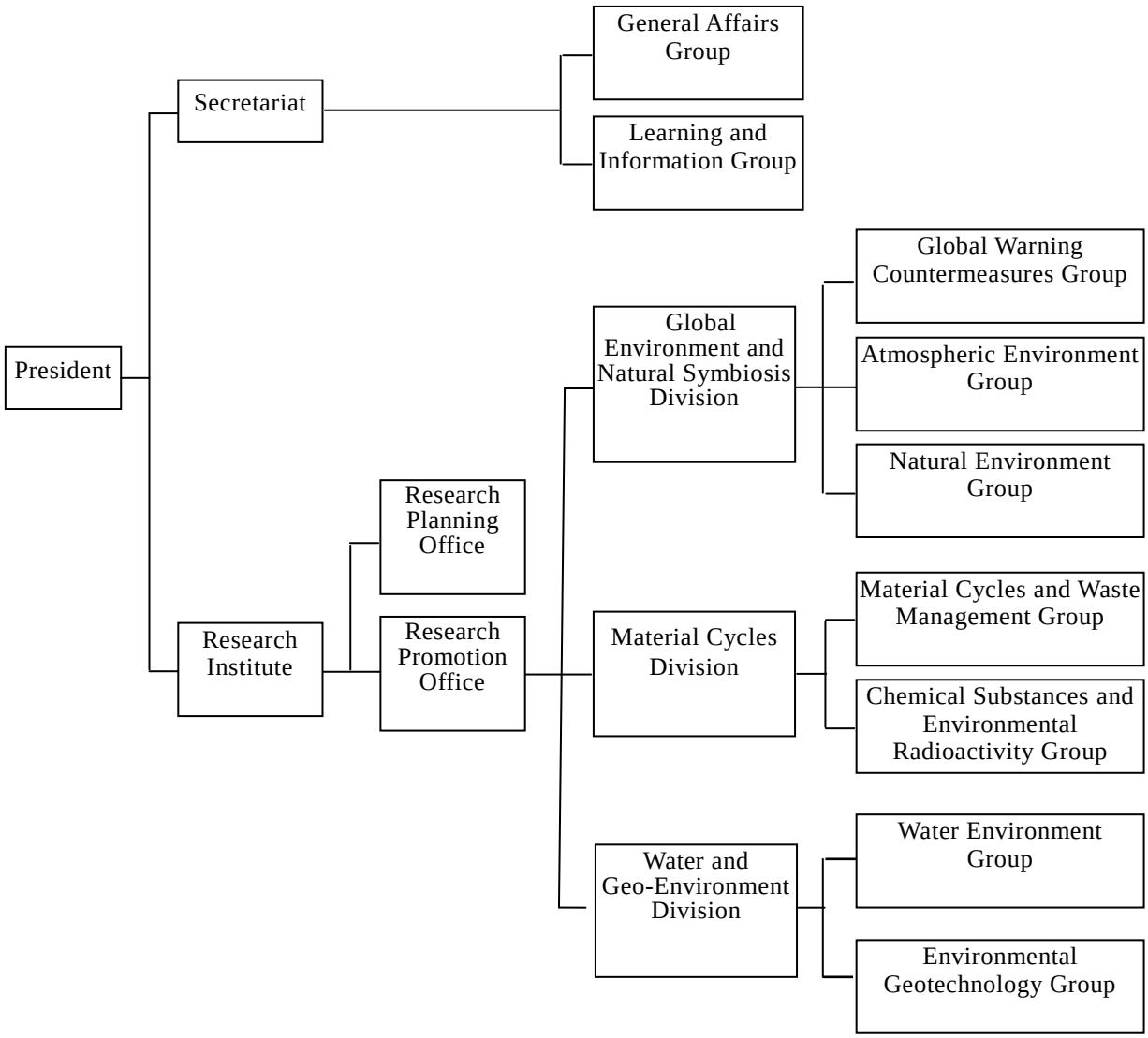
(1) Influence on Evapotranspiration by Photovoltaic Power Generation Equipment on Landfill Sites (Material Cycles and Waste Management Group: T. Hase / 2015–2017)

Since the enforcement of the Feed-in Tariff law for renewable energy in 2012, photovoltaic power (PV) generation has been actively embraced in Japan. As a result, the spacious areas available on landfill sites are being increasingly used to install PV generation systems. However, there is a fear that the introduction of PV equipment on landfill sites may influence landfill management by, inter alia, decreasing evapotranspiration, increasing the volume of leachate, and increasing leachate treatment costs. This is because the PV equipment shades the landfill surface, and evapotranspiration is one of the factors controlling water balance in landfill sites. In this research, I will observe surface climatic parameters such as temperature and solar radiation on a landfill site where PV generation equipment is installed to estimate the influence of changes in evapotranspiration on the water balance in landfill sites.

(2) Study on gaseous mercury in solid waste landfills (Material Cycles and Waste Management Group: M. Nagamori, T. Hase; Research Promotion Office: Y. Watanabe; 2016–2018)

Mercury-bearing materials have been disposed of in waste landfills from a wide array of sources, including thermometers, batteries, and general waste. Despite the known volatility and toxicity of mercury in the environment, quantitative estimations of mercury emissions from waste landfills on the basis of field measurements have not been widely performed in Japan. As a result of the signing and adoption of the Minamata Convention on Mercury at a diplomatic meeting of the United Nations Environment Programme in October 2013, the discharge and disposal of mercury will now be regulated on a global scale. In this study we intend to examine methods of gaseous mercury collection and to then measure the fluxes of gaseous mercury from gas ventilation pipes and the surfaces of waste landfills. We will then approximate the amounts of gaseous mercury emitted from entire waste landfills.

Organization of Center for Environmental Science in Saitama (CESS)



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