Roadmap for the Environment & Food Unit
Integrated Initiative for Designing Future Society

	AY2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
	Fourth Medium-Term Objectives for the 2022–2027 Period						Fifth Medium-Term Objectives for the 2028–2033 Period			

Environment and Food Unit

Goals for 2030:
- ○ Decision-making support for environmental policy using future prediction models of atmospheric and oceanic environments
- ○ Establishing sustainable food and agricultural ecosystems by developing new varieties through genome breeding

Goals and Vision
The Environment and Food Unit is committed to tackling environmental challenges that span a broad scope, including climate change and air and marine pollution, both of which have significant and wide-ranging impacts. We're also dedicated to creating a sustainable supply system for safe, secure food, always prioritizing the preservation of our global environment. Our approach includes conducting in-depth research in atmospheric and marine sciences for improved understanding and mitigation of air and sea environmental issues. Furthermore, our food and agricultural research efforts involve innovative strategies such as aquaculture, breeding technologies, and the resourceful conversion of non-edible materials. All these initiatives are part of our mission to give back to society and bring practical solutions to fruition on both national and international scales. Our research findings will contribute to solving multifaceted social issues in regions facing environmental and food problems.

Unit meetings held as necessary for goal sharing, strengthening cooperation, sharing issues, progress reports, etc.

Environmental and Economic Policy Research Group

Goals for 2030:
- ○ Create policy recommendations based on the impact analysis of demand policies, technology policies, and supply chain policies on environmental load reduction

Develop an integrated analytical framework for analyzing the environmental impact of demand-side, technology, and supply chain policies; conduct case studies of automobiles and other vehicles. Specifically, we will pursue research on the following three questions:

Question 1: How do demand-side policies affect the life-cycle environmental impact of durable goods?

Question 2: How do technological changes in a certain country/sector affect the life-cycle environmental impact?

Question 3: How do changes to the supply chain in a certain country/sector affect the life-cycle environmental impact?

Expand the integrated analytical framework and develop a tool to support environmental policy decisions using that framework in addition to making policy recommendations

- ● Group Initiatives
- ● Project Initiatives

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Atmospheric Science Research Group

Goals for 2030:
- Refine the quantitative evaluation of climate change through the study of the basic processes of clouds and aerosols

- Group Initiatives
- Project Initiatives

- Explore the optimal reduction path for short-lived climate forcer (SLCF) emissions by using numerical models to evaluate the impact of SLCFs, such as aerosols, on climate change
- Analyze the macroscopic characteristics and microphysical properties of clouds, precipitation, and aerosols to gain a quantitative understanding of the interactions between clouds, aerosols, and radiation by combining satellite-mounted cloud radars and lidars with ground observations
- Develop a new atmospheric quality analysis system that integrates advanced remote sensing and numerical models, construct forecast and reanalysis products that accurately reproduce the atmospheric environment, and, through these efforts, promote atmospheric environmental research

- "Assessment on climate impacts of short-lived climate forcers by composition and region with hierarchical numerical models" funded by Grants-in-Aid for Scientific Research (S)
- "Research on mitigation to climate change and environmental impacts caused by short-lived climate forcers" funded by Strategic Research and Development (I) S-20 of the Environment Research and Technology Development Fund
- Collaborate with policymakers (UN/APCAP, UN/CCAC, IPCC, etc.) based on research findings to reduce SLCFs

- Create a longitudinal data set of the microphysical properties of clouds and aerosols since 2006 based on synchronous analysis of CloudSat radar and CALIPSO lidar to understand the global properties of clouds and aerosols
- Understand the global properties of clouds, aerosols, radiation, and vertical flow from analysis of the four sensors aboard the EarthCARE satellite, including cloud-profiling radar (CPR) with Doppler capability and high-spectral-resolution lidar (HSRL)
- Create a longitudinal data set consistent with observed data and radiometric properties derived from microphysical properties of clouds and aerosols since 2006 based on synchronous analysis of data from CloudSat radar, CALIPSO lidar, AQUA onboard imager, and radiometry in order to understand the global properties of radiation

- "Improving the accuracy of air pollution prediction using machine learning" funded by the Environment Research and Technology Development Fund
- "Study on simultaneous assimilation of multiple aerosol elements by integrating remote sensing and numerical modeling" funded by a Grant-in-Aid for Scientific Research (A)
- Develop a system of analysis that integrates satellite measurements and numerical models

Roadmap for the Environment & Food Unit
Integrated Initiative for Designing Future Society

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Marine Science Research Group

Goals for 2030:
- ○ Refine the study of basic ocean-related processes in the East Asia and Pacific region and apply them to the study of environmental changes

- ● Group Initiatives
- ● Project Initiatives

Marine environment research: Elucidating the behavior of marine pollutants such as microplastics; improving the accuracy of predictions on the impact of oceanic changes on weather, climate, fisheries, and other industrial structures; and gaining a new picture of the ocean using the latest in advanced satellite remote sensing technologies

Ocean-Atmosphere Interactions: Promoting research that focuses on the influence of the oceans on relatively localized meteorological phenomena and large-scale meteorological and climatic systems on a continental-oceanic scale; reproducing local extreme weather events, which have attracted attention in recent years; and studying the impacts of marginal ocean phenomena at the scale of the Japan archipelago as well as the impacts of atmospheric-oceanic phenomena on a Pacific scale

Expand research at the Center for Ocean Plastic Studies and growth into a global research hub

Achieve JICA/JST-funded SATREPS project objectives and strengthen collaborations with Southeast Asian researchers on relevant themes

Complete research objectives related to understanding the current amount of fine microplastics as well as forecasting future amounts, which is currently being studied under a Grant-in-Aid for Scientific Research (S)

Nationwide deployment of coastal marine condition forecasting with fishers, which has been demonstrated in three prefectures in northern Kyushu

International development of coastal marine condition forecasting with fishers

Add mechanical processes such as wave mixing, sea ice changes, and non-hydrostatic processes, which are currently lacking in the Research Institute for Applied Mechanics Ocean Model (RIAMOM)

Integrated modeling of physical, chemical, and biological processes and data assimilation

"Promotion of research on the assessment of global warming impacts and future climate prediction in the East Asia and North Pacific region," funded by the Kyushu University Reform Revitalization Program

Promote research on the interaction between tropical ocean basins and their impact on mid-latitude climate as it relates to the WCRP-CLIVAR Research Focus (RF) on Tropical Basin Interaction (TBI)

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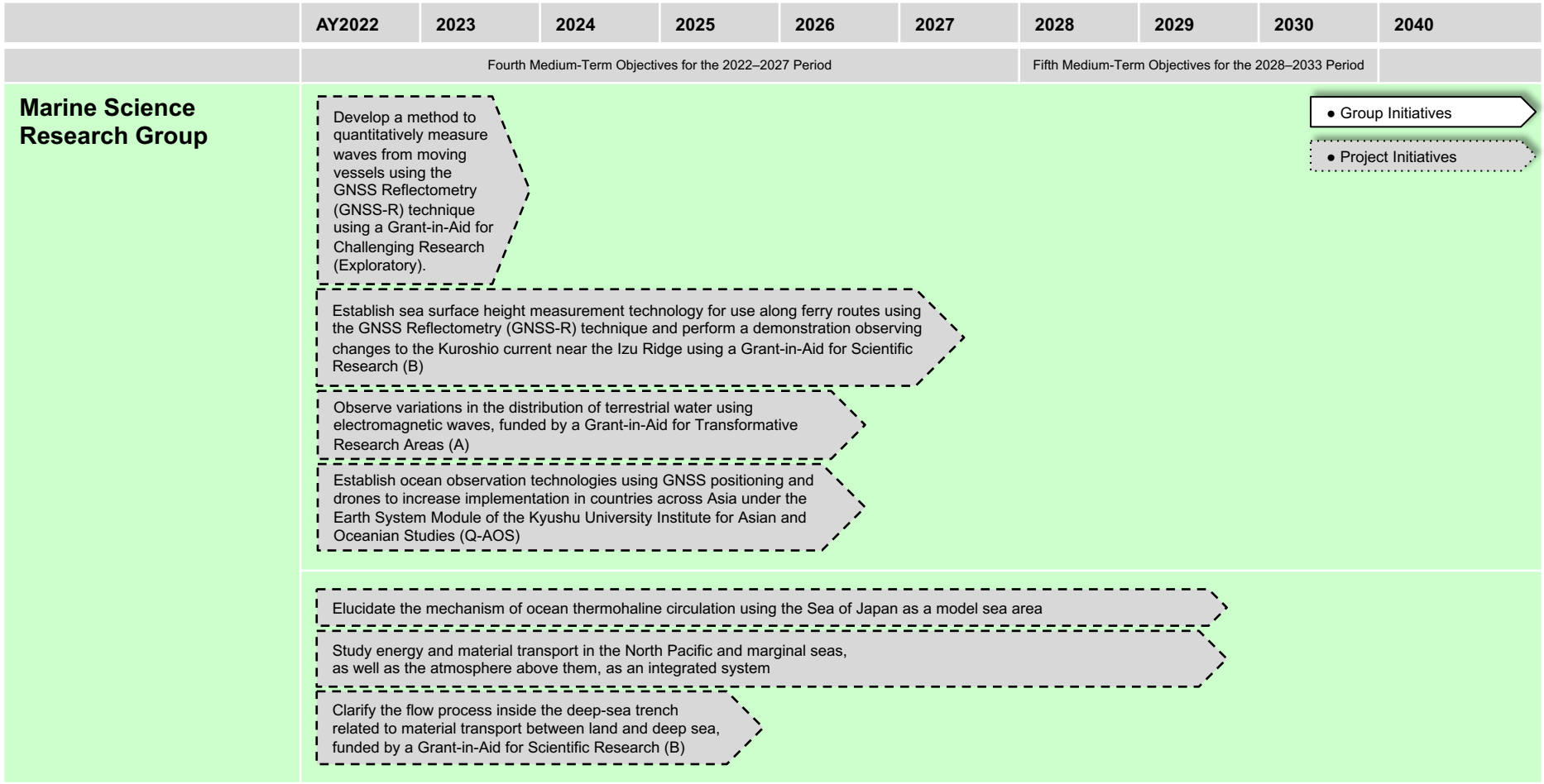
Marine Science Research Group

- Group Initiatives
- Project Initiatives

- Achieve research objectives related to “Exchange of water and material between shelf area and Kuroshio region and its influences on the primary production,” funded by a Grant-in-Aid for Transformative Research Areas (A)
- Achieve research objectives and strengthen collaboration with Southeast Asian researchers related to turbulent mixing in Asian marginal seas as outlined in “Healthy, Productive and Sustainable Asian Marginal Seas: Understanding changes in the marine environment in response to global climate change” funded by the IOC-WESTPAC Project
- Strengthen collaboration with researchers from the US and achieve research objectives related to turbulent mixing generated by the interaction between the Kuroshio current and islands in the Tokara Strait as set out in the NSF Project "Lee Waves and Turbulence Forced by the Kuroshio" and joint research at Kyushu University’s Applied Mechanics Research Institute, titled "Multiple time-scale Kuroshio variations driven by the East Asian Monsoon"
- Strengthen collaboration with researchers from Taiwan and achieve the research objectives related to joint research at Kyushu University’s Applied Mechanics Research Institute, titled "Turbulent mixing in the Kuroshio Current off Taiwan"
- "Elucidation of Material Circulation between Rivers and Oceans Using Drones" being developed under a Grant-in-Aid for Scientific Research (B)
- Evaluate sea level changes in the waters around Japan using the new satellite altimeter of the Surface Water and Ocean Topography (SWOT) mission
- Promote understanding of climate change and atmosphere-ocean interaction in the waters around Japan, which is currently being studied under a Grant-in-Aid for Scientific Research on Innovative Areas
- Develop an integrated ocean-river model

Roadmap for the Environment & Food Unit
Integrated Initiative for Designing Future Society



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- Group Initiatives
- Project Initiatives

Aquatic Food Production Research Group

Goals for 2030:
- Build a next-generation aquaculture industry

- Conduct industry-academia-government collaborations that span from production to distribution, using chub mackerel as a model, such as the project supported by the Cross-ministerial Strategic Innovation Promotion Program (SIP) to develop strategic breeding and production infrastructure for the expansion of fully farmed chub mackerel and overseas exports
- Develop and implement strategic aquaculture varieties suitable for urban production and a food production system using aquaponics and IoT through a joint industry-academia-government urban aquafarming project
- Develop new varieties using genomic information and genome editing
- Develop methods for the preservation and individual regeneration of strains, varieties, and biological resources through reproductive stem cell manipulation
- Develop fertility control methods to prevent spillage of farmed fish and effectively produce the next generation of fish
- Promote branding of genetically modified fish, protect intellectual property, and develop social implementation strategies
- Develop feed based on insect, plant, and other materials that do not depend on fish meal derived from natural resources
- Develop sustainable production and utilization technologies for marine invertebrates (such as sea urchins and bivalves), algae, and marine microorganisms
- Develop energy-efficient smart land-based aquaculture and aquaponics systems

Food Science Research Group

Goals for 2030:
- Establish foodomics and food DX technologies to evaluate and improve individual safety, security, health, and comfort through comprehensive analysis of factors related to food and health

- Establish analytical methods that enable comprehensive and simultaneous detection and evaluation of chemical components corresponding to food and health factors
- Develop technology to record, transmit, and reproduce human chemosensory information such as taste, smell, and color that transcends time and space
- Develop non-invasive monitoring technology for biological information and health risks, including dietary response
- Develop new food design technology that takes into account food preferences and responses by assessing individual sensory responses and health risks of individuals to food
- Develop technology that enables comprehensive and simultaneous detection and quantification of food components that contribute to taste, aroma, and color and construct algorithms to evaluate and predict human sensory responses
- Develop a comprehensive measurement reporting system for metabolome information that reflects biological information and construct algorithms to evaluate and predict biological information and disease risk, including dietary response
- Establish quantitative visualization technology for contributing factors related to the food environment, including microbes and freshness, and construct algorithms to evaluate and predict these factors

July 8, 2022

Unit Name: Environment and Food

Unit Leader Name: Susumu Fukuda

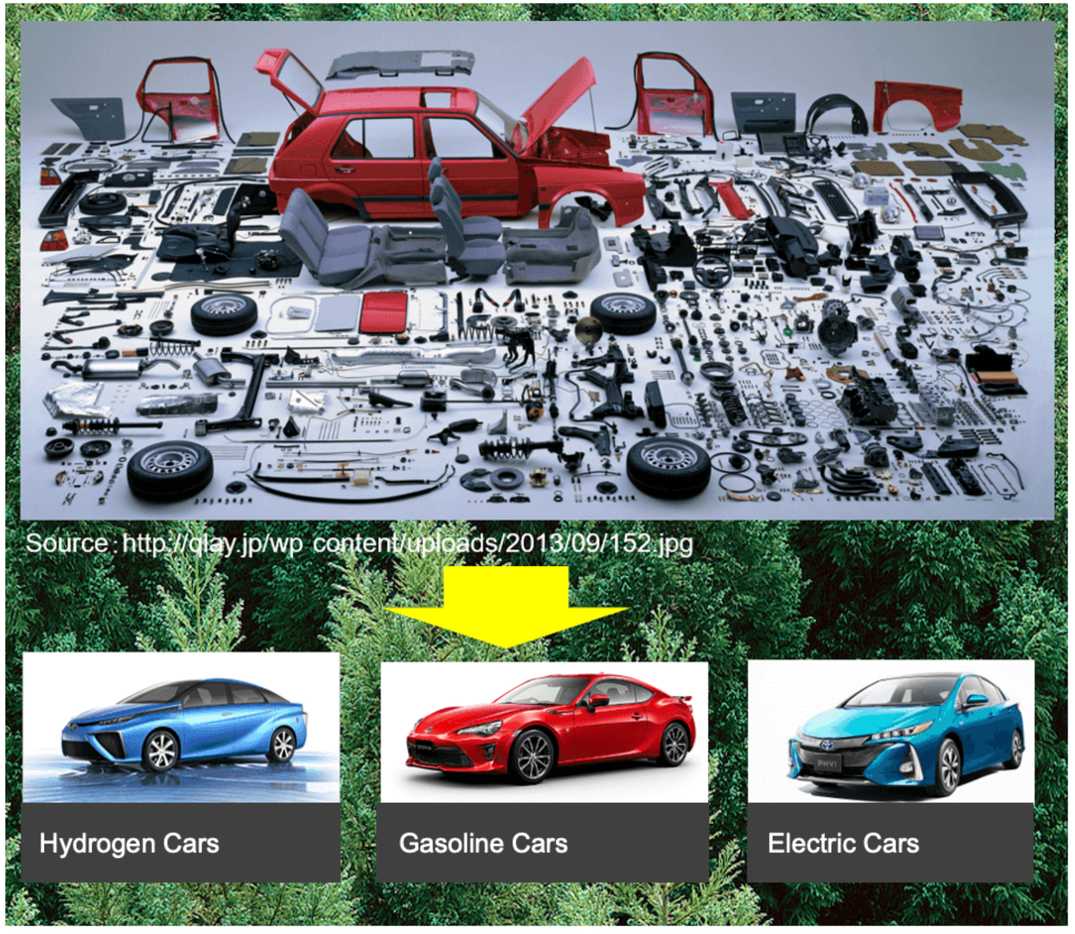
Group Leader Name: Hidemichi Fujii

Group Name	Goal	Project Manager			Action Item 1	Action Item 2	Action Item 3	Action Item 4	Action Item 5	Collaborations (e.g., Other groups, other units, DDIn[2])	Project URL
		Affiliation	Position	Name							
Environmental and Economic Policy Research Group	Group-wide: Goal for 2030: Create policy recommendations based on the impact analysis of demand policies, technology policies, and supply chain policies on environmental load reduction	Faculty of Economics	Associate Professor	Hidemichi Fujii	Develop an integrated analytical framework for analyzing the environmental impact of demand-side, technology, and supply chain policies as well as conduct case studies of automobiles and other vehicles with a research focus on the following three questions: Question 1: How do demand-side policies affect the life-cycle environmental impact of durable goods? Question 2: How do technological changes in a certain country/sector affect the life-cycle environmental impact? Question 3: How do changes to the supply chain in a certain country/sector affect the life-cycle environmental impact? (Initiative Period: 2022–2027)	Expand the integrated analytical framework and develop a tool to support environmental policy decisions using that framework in addition to making policy recommendations (Initiative Period: 2028–2030)					

Environment and Food

Environmental Economics Research Platform

Research Subject: Durable Goods in General (Automobiles, Buildings, etc.)



Constructing a Low-Carbon and Decarbonized Supply Chain is of Critical Importance

2022 2023 2024 2025 2026 2027 2028 2029 2030

Develop an integrated analytical framework and case studies for analyzing the environmental impact of demand-side, technology, and supply chain policies

Q1 How do demand-side policies affect the life-cycle environmental impact of durable goods (e.g., CO_2 emissions)?

Q2 How do technological changes in a certain country/sector affect the life-cycle environmental impact (e.g., CO_2 emissions)?

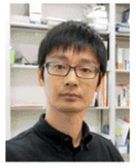
Q3 How do changes to the supply chain in a certain country/sector affect the life-cycle environmental impact (e.g., CO_2 emissions)?

Related Analysis Methods *MRIO, DEA, SFA, Network, Product lifetime, Decomposition, LCA*

★ Creation of New Network Economics


Prof. Kagawa


Prof. Managi


Prof. Fujii


Prof. Chapman


Prof. Hanaka


Dr. Nakaishi

Goals for 2030:

- Create policy recommendations based on the impact analysis of demand policies, technology policies, and supply chain policies on environmental load reduction
- Foster researchers in the field of environmental economics

九州大学 KYUSHU UNIVERSITY

List of Group Initiatives

July 11, 2022

Unit Name: Environment and Food

Unit Leader Name: Susumu Fukuda

Group Leader Name: Toshihiko Takemura

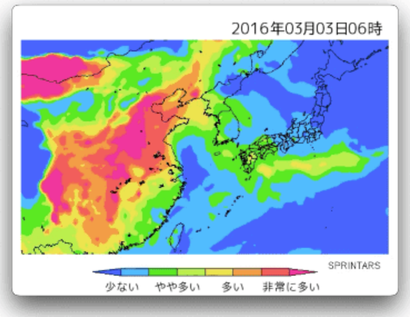
Group Name	Goal	Project Manager			Action Item 1	Action Item 2	Action Item 3	Action Item 4	Action Item 5	Collaborations (e.g., Other groups, other units, DDIn[2])	Project URL
		Affiliation	Position	Name							
Atmospheric Science Research	Group-wide: Goal for 2030: Refine the quantitative evaluation of climate change through the study of the basic processes of clouds and aerosols				Explore the optimal reduction path for short-lived climate forcer (SLCF) emissions by using numerical models to evaluate the impact of SLCFs such as aerosols on climate change. (Initiative Period: through 2030)	Analyze the macroscopic characteristics and microphysical properties of clouds, precipitation, and aerosols to gain a quantitative understanding of the interactions between clouds, aerosols, and radiation by combining satellite-mounted cloud radars and lidars with ground observations (Initiative Period: through 2030)	Develop a new atmospheric quality analysis system that integrates advanced remote sensing and numerical models, construct forecast and reanalysis products that accurately reproduce the atmospheric environment, and, through these efforts, promote atmospheric environmental research (Initiative Period: through 2030)	–	–	Collaborating with the Marine Science Research Group at the Research Institute for Applied Mechanics	https://www.riam.kyushu-u.ac.jp/project_taikai/
	Short-Lived Climate Forcers Research Project: Goal for 2030: Create scientific knowledge that will contribute to international policies by quantifying the climate change mitigation effects of reducing Short-Lived Climate Forcers (SLCFs)	Research Institute for Applied Mechanics	Professor	Toshihiko Takemura	Grant-in-Aid for Scientific Research (S) Quantitative climate impact assessment of short-lived climate forcers by composition and region through hierarchical numerical models (Initiative Period: 2019–2023)	Strategic Research and Development (I) S-20, Environment Research and Technology Development Fund Research on mitigation to climate change and environmental impacts caused by short-lived climate forcers (Initiative Period: 2021–2025)	Collaborate with policymakers (UN/APCAP, UN/CCAC, IPCC, etc.) based on research findings to reduce SLCFs (Initiative Period: through 2030)	–	–		https://www.riam.kyushu-u.ac.jp/climate/ https://www.riam.kyushu-u.ac.jp/climate/KAKENHI_S/ https://www.riam.kyushu-u.ac.jp/climate/S-20/
	Cloud, Aerosol, Radiation, and Convection Research Project: Goal for 2030: Extract microphysical characteristics of clouds and aerosols globally from satellite analysis and calculate radiative properties globally, aiming to match within 10W/m2 at a resolution of 10km at the top of the atmosphere	Research Institute for Applied Mechanics	Professor	Hajime Okamoto	Create a longitudinal data set of the microphysical properties of clouds and aerosols since 2006 based on synchronous analysis of CloudSat radar and CALIPSO lidar to understand the global properties of clouds and aerosols (Initiative Period: through 2030)	Understand the global properties of clouds, aerosols, radiation, and vertical flow from analysis of the four sensors aboard the EarthCARE satellite, including cloud-profiling radar (CPR) with Doppler capability and high-spectral-resolution lidar (HSRL) (Initiative Period: through 2030)	Create a longitudinal data set consistent with observed data and radiometric properties derived from microphysical properties of clouds and aerosols since 2006 based on synchronous analysis of data from CloudSat radar, CALIPSO lidar, AQUA onboard imager, and radiometry in order to understand the global properties of radiation (Initiative Period: through 2030)	–	–		https://www.riam.kyushu-u.ac.jp/gfd/okamoto_project2.html https://www.riam.kyushu-u.ac.jp/gfd/okamoto_project3.html
	Air Quality Data Assimilation Project: Goal for 2030: Develop a new atmospheric quality analysis system integrating advanced remote sensing and numerical models, construct forecasting and reanalysis products that accurately reproduce the atmospheric environment, and, through these efforts, promote atmospheric environmental research	Research Institute for Applied Mechanics	Professor	Keiya Yumimoto	Environment Research and Technology Development Fund Improving the accuracy of air pollution prediction using machine learning (Initiative Period: 2020–2024)	Grant-in-Aid for Scientific Research (A) Study on simultaneous assimilation of multiple aerosol elements by integrating remote sensing and numerical modeling (Initiative Period: 2022–2026)	Develop a system of analysis that integrates satellite measurements and numerical models (Initiative Period: through 2030)	–	–	Collaborating on research with the Pan-Omics Data-Driven Research Innovation Center	https://www.riam.kyushu-u.ac.jp/taikai/JRAero/

Environment and Food

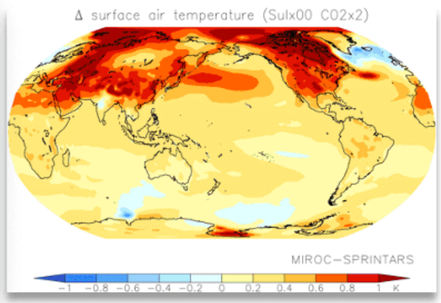
Atmospheric Science Research

Achievements to Date

- Developed numerical model SPRINTARS to simulate the processes by which atmospheric particles (aerosols) are transported and their effects on climate
- Provide daily forecasts of PM2.5 levels to the public



PM2.5 forecast



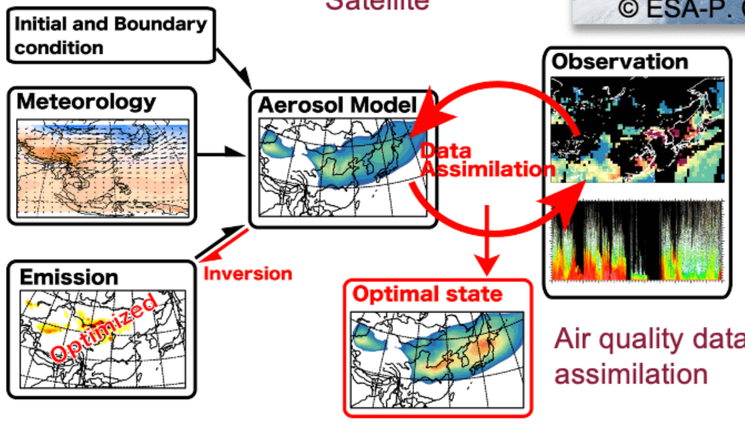
Predicted rise in temperature due to the reduction in aerosols and increase in CO_2

- Led the understanding of cloud characteristics using active sensors and the joint EU-Japan proposal for the EarthCARE satellite project
- Research into data assimilation integrating satellite-based measurements and observations of air quality with numerical simulations

Current Research

- **Explore the optimal reduction path for short-lived climate forcer (SLCF) emissions to quantitatively evaluate the impact of SLCFs such as aerosols on climate change and the environment**
- **Develop a new air quality analysis system that integrates advanced telemetry and numerical models**
- **Build on a quantitative understanding of the interactions between clouds, aerosols, and radiation by combining active sensors aboard the EarthCARE satellite with ground-based observations**

The EarthCARE Satellite

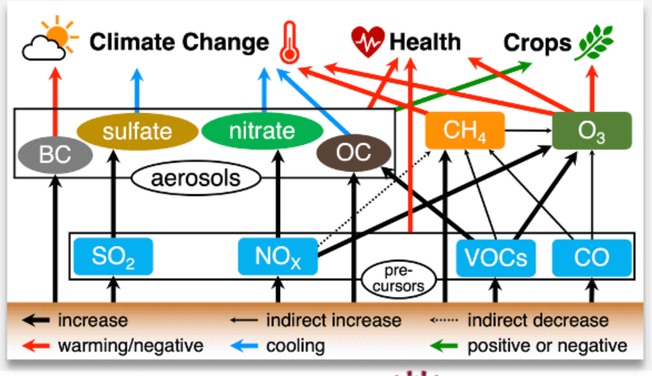


Air quality data assimilation

Future Plans

Generate new scientific knowledge about the atmospheric environment

- Collaborate with policymakers (UN/APCAP, UN/CCAC, IPCC, etc.) based on research findings regarding climate change and atmospheric environment to reduce SLCFs
- Develop forecasting and reanalysis products that accurately reproduce atmospheric conditions



九州大学 KYUSHU UNIVERSITY

List of Group Initiatives

July 28, 2022

Unit Name: Environment and Food

Name of Unit Leader: Executive Vice President Susumu Fukuda

Group Leader Name: Atsuhiko Isobe

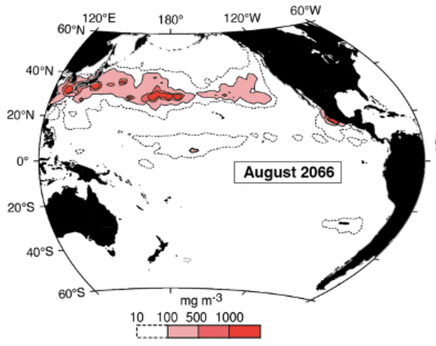
Group Name	Goal	Project Manager			Action Item 1	Action Item 2	Action Item 3	Action Item 4	Action Item 5	Collaborations (e.g., Other groups, other units, DDIn[2])	Project URL
		Affiliation	Position	Name							
Marine Science Research	Group-wide: Goal for 2030: Refine the study of basic ocean-related processes in the East Asia and Pacific region and apply them to the study of environmental changes				Marine environment research: Elucidating the behavior of marine pollutants such as microplastics; improving the accuracy of predictions on the impact of oceanic changes on weather, climate, fisheries, and other industrial structures; and gaining a new picture of the ocean using the latest in advanced satellite remote sensing technologies (Initiative Period: ongoing since 2017)	Ocean-Atmosphere Interactions: Promoting research that focuses on the influence of the oceans on relatively localized meteorological phenomena and large-scale meteorological and climatic systems on a continental-oceanic scale; reproducing local extreme weather events, which have attracted attention in recent years; and studying the impacts of marginal ocean phenomena at the scale of the Japan archipelago as well as the impacts of atmospheric-oceanic phenomena on a Pacific scale. (Initiative Period: ongoing since 2017)	–	–	–	Collaborating with the Atmospheric Research Group at the Research Institute for Applied Mechanics	https://www.riam.kyushu-u.ac.jp/project_taikai/
	Ocean Plastics Studies Project Goal for 2030: Contribute to the creation of action plans by providing scientific evidence aimed at creating a society that uses less plastic	Research Institute for Applied Mechanics	Professor	Atsuhiko Isobe	Expansion of research at the Center for Ocean Plastic Studies and growth into a global research hub (Initiative Period: ongoing since 2022)	Achievement of JICA/JST-funded SATREPS project objectives and strengthening of cooperation with Southeast Asian researchers on relevant themes (Initiative Period: 2020–2025)	Complete research objectives related to understanding the current amount of fine microplastics as well as forecasting future amounts, which is currently being studied under a Grant-in-Aid for Scientific Research (S) (Initiative Period: 2021–2025)	–	–	For initiatives 1 and 3: collaborating on research with the Faculty of Agriculture, the Faculty of Science, and the Research Center for Negative Emissions Technologies	https://sites.google.com/view/riam-cops-jp
	Smart Fisheries Research Project Goal for 2030: Implement smart technology in 1,000 small fishing boats and dramatically improve the accuracy of forecasts for coastal sea conditions	Research Institute for Applied Mechanics	Professor	Naoki Hirose	Nationwide deployment of coastal marine condition forecasting with fishers, which has been demonstrated in three prefectures in northern Kyushu (Initiative Period: 2022–2025)	International development of coastal marine condition forecasting with fishers (Initiative Period: 2026–2030)	Add mechanical processes such as wave mixing, sea ice changes, and non-hydrostatic processes, which are currently lacking in the Research Institute for Applied Mechanics Ocean Model (RIAMOM) (Initiative Period: 2022–2030)	Integrated modeling of physical, chemical, and biological processes and data assimilation (Initiative Period: 2026–2030)		Joint collaborative research under MoU with 22 institutions from industry, academia, and government	https://www.riam.kyushu-u.ac.jp/omg/sfin.html.ja
	Climate Change Dynamics Research Project Goal for 2030: Clarify the roles of the ocean and sea ice in global warming and other climate changes, contributing to the creation of scientific knowledge for the UN Ocean Decade and the IPCC	Research Institute for Applied Mechanics	Professor	Hiroki Tokinaga	"Promotion of research on the assessment of global warming impacts and future climate prediction in the East Asia and North Pacific region," funded by the Kyushu University Reform Revitalization Program (Initiative Period: 2020–2024)	Promote research on the interaction between tropical ocean basins and their impact on mid-latitude climate as it relates to the WCRP-CLIVAR Research Focus (RF) on Tropical Basin Interaction (TBI) (Initiative Period: 2020–2024)	–	–	–	Collaborating on research as part of Grant-in-Aid for Scientific Research on Innovative Areas project "Mid-latitude ocean-atmosphere interaction hotspots under the changing climate"	https://www.riam.kyushu-u.ac.jp/oed/tokinaga/
	Ocean Turbulence Research Project Goal for 2030: Clarify the role of turbulent mixing in the ocean in material circulation and contribute to the quantitative evaluation of the marine environment in the marginal seas of East Asia	Research Institute for Applied Mechanics	Associate Professor	Takahiro Endoh	Achieve research objectives related to "Exchange of water and material between shelf area and Kuroshio region and its influences on the primary production," funded by a Grant-in-Aid for Transformative Research Areas (A) (Initiative Period: 2022–2027)	Achieve research objectives and strengthen collaboration with Southeast Asian researchers related to turbulent mixing in Asian marginal seas as outlined in "Healthy, Productive and Sustainable Asian Marginal Seas: Understanding changes in the marine environment in response to global climate change" funded by the IOC-WESTPAC Project (Initiative Period: 2021–2030)	Strengthen collaboration with researchers from the US and achieve the research objectives related to turbulent mixing generated by the interaction between the Kuroshio current and islands in the Tokara Strait as set out in the NSF Project "Lee Waves and Turbulence Forced by the Kuroshio" and joint research at Kyushu University's Applied Mechanics Research Institute, titled "Multiple time-scale Kuroshio variations driven by the East Asian Monsoon." (Initiative Period: 2019–2023)	Strengthen collaboration with researchers from Taiwan and achieve the research objectives related to joint research at Kyushu University's Applied Mechanics Research Institute, titled "Turbulent mixing in the Kuroshio Current off Taiwan" (Initiative Period: ongoing since 2018)	–	Action Item 1: Ehime University, Nagasaki University, Kagoshima University, University of Toyama Action Item 3: University of Washington, Kagoshima University, Tokyo University of Marine Science and Technology, Japan Agency for Marine-Earth Science and Technology, The University of Tokyo Action Item 4: National Taiwan University, Tokyo University of Marine Science and Technology, Ehime University, Kagoshima University	https://www.riam.kyushu-u.ac.jp/ocd/index-j.htm
	Land-Sea Interaction Research Project Goal for 2030: Contribute to the understanding of the factors causing environmental changes in coastal areas under climate change and the role played by rivers and inland waters	Research Institute for Applied Mechanics	Associate Professor	Shinichiro Kida	"Elucidation of Material Circulation between Rivers and Oceans Using Drones" being developed under Grant-in-Aid for Scientific Research (B) (Initiative Period: 2021–2023)	Evaluate sea level changes in the waters around Japan using the new satellite altimeter of the Surface Water and Ocean Topography (SWOT) mission (Initiative Period: 2020–2023)	Promote understanding of climate change and atmosphere-ocean interaction in the waters around Japan, which is currently being studied under a Grant-in-Aid for Scientific Research on Innovative Areas (Initiative Period: 2019–2023)	Develop an integrated ocean-river model (Initiative Period: 2020–2025)	–	Collaborating on research with the Faculty of Science and the School of Interdisciplinary Science and Innovation	https://www.riam.kyushu-u.ac.jp/opg/
	Wide-Area and High-Frequency Coastal Observation Project Goal for 2030: Develop inexpensive and innovative observation methods in coastal areas where the density and frequency of observation points are insufficient and serve as a springboard for the explosive development of observation networks in domestic and international operational agencies and NGOs	Research Institute for Applied Mechanics	Associate Professor	Kaoru Ichikawa	Develop a method to quantitatively measure waves from moving vessels using the GNSS Reflectometry (GNSS-R) technique using a Grant-in-Aid for Challenging Research (Exploratory). (Initiative Period: FY2021–FY2023)	Establish sea surface height measurement technology for use along ferry routes using the GNSS Reflectometry (GNSS-R) technique and perform a demonstration observing changes to the Kuroshio current near the Izu Ridge using a Grant-in-Aid for Scientific Research (B) (Initiative Period: 2022–2027)	Observe variations in the distribution of terrestrial water using electromagnetic waves, funded by a Grant-in-Aid for Transformative Research Areas (A) (Initiative Period: 2021–2026)	Under the Earth System Module of the Kyushu University Institute for Asian and Oceanian Studies (Q-AOS), establish ocean observation technologies using GNSS positioning and drones to increase implementation in countries across Asia (Initiative Period: 2021–2026)	–	Collaborating with the French space agency CNES on the international Surface Water and Ocean Topography (SWOT) mission and with the American space agency NASA on the Cyclone Global Navigation Satellite System (CYGNSS) mission	https://oed.official.jp/ichikawa
	North Pacific Marginal Seas Dynamics Analysis Project Goal for 2030: Elucidate the physical, chemical, and biological processes of the marginal seas of the North Pacific, primarily the Sea of Japan, and evaluate the impacts of climate change	Research Institute for Applied Mechanics	Associate Professor	Tomoharu Senjyu	Elucidation of the mechanism of ocean thermohaline circulation using the Sea of Japan as a model sea area (Initiative Period: 2020–2030)	Study energy and material transport in the North Pacific and marginal seas, as well as the atmosphere above them, as an integrated system (Initiative Period: 2020–2030)	Clarify the flow process inside the deep-sea trench related to material transport between land and deep sea, funded by a Grant-in-Aid for Scientific Research (B) (Initiative Period: 2022–2025)			Collaborating on research with multiple universities in Japan and fisheries research institutions facing the Sea of Japan and the East China Sea	https://www.riam.kyushu-u.ac.jp/ocd/index-j.htm

Environment and Food

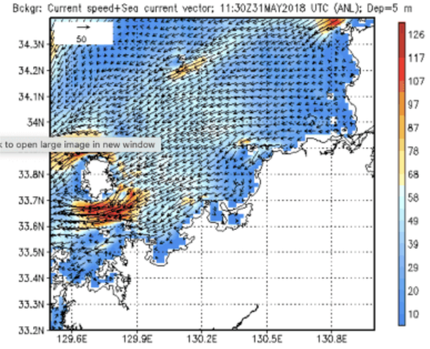
Marine Science Research

Achievements to Date

- Developed a numerical model of the processes by which marine microplastics are transported that can predict the amounts suspended in oceans
- Established the Center for Ocean Plastic Studies, an overseas research center for marine plastic pollution



Forecasting the amount of microplastics suspended in oceans



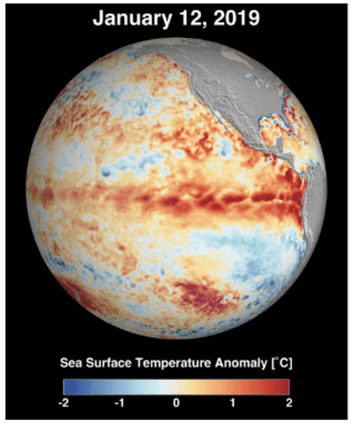
Using models to provide fishing-related information

- Smart fisheries research: providing fishers with coastal marine condition forecasts using an ocean assimilation product
- Climate change dynamics research:Revealed the mechanisms that form climate change patterns in tropical oceans

Current Research

- **Explain the flow of plastic waste in the global environment, including both land and sea**
- **Track and analyze missing plastic, including microplastics, at a microscopic level**
- **Nationwide and international deployment of coastal marine condition forecasting with fishers, which has been demonstrated in three prefectures in northern Kyushu**
- **"Promotion of research on the assessment of global warming impacts and future climate prediction in the East Asia and North Pacific region," funded by the Kyushu University Reform Revitalization Program**
- **The interaction between tropical basins and their effects on mid-latitude climate**

Marine plastics are just the tip of the iceberg

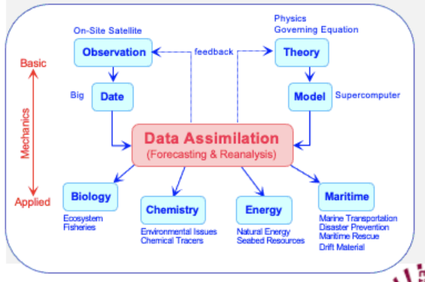


Deviations in sea surface temperature in tropical oceans

Future Plans

Generate new scientific knowledge and collaborate with wider society on issues related to the marine environment and climate change

- Propose an action plan to reduce plastics based on scientific evidence
- Use the latest marine science to dramatically improve the accuracy of coastal fishing and marine condition forecasts
- Reveal the role of oceans and sea ice in climate change (contribute to the UN Ocean Decade and IPCC)



Cooperative framework for smart fisheries

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List of Group Initiatives

January 16, 2023

Unit Name: Environment and Food

Unit Leader Name: Susumu Fukuda

Group Leader Name: Takahiro Kusakabe

Group Name	Goal	Project Manager			Action Item 1	Action Item 2	Action Item 3	Action Item 4	Action Item 5	Collaborations (e.g., Other groups, other units, DDIn[2])	Project URL
		Affiliation	Position	Name							
Insect Science Research	Group-wide: Goal for 2050: Develop insect science to avoid trade-offs between food production, infectious disease control, biodiversity, and the global environment				Rediscover and add value to insect resources (Initiative Period: ongoing since 2022)	Develop a system for predicting the spread of sanitary insects (Initiative Period: 2025–2030)	Develop low-cost insect feed (Initiative Period: 2022–2040)	–	–		
	Project A: Insect Bioinformatics Goal for 2040: Predict environmental changes and other dynamics using insect fauna as an indicator	Faculty of Agriculture	Associate Professor	Satoshi Kamitani	Develop automated insect species identification technology (Initiative Period: 2022–2027)	Establish high-precision digitization technology for specimen data (Initiative Period: 2023–2030)	–	–	–	Establish high-precision digitization technology for specimen data with the Research Institute for Information Technology; develop a trial AI and insect species identification app	http://www.agr.kyushu-u.ac.jp/lab/entomology/index.html
	Project B: Insect Industry Creation Studies Goal for 2030: Develop insect science that can produce foods people will feel safe eating	Faculty of Agriculture	Professor	Takahiro Kusakabe	Promote research on insects as a food resource (Initiative Period: 2022–2030)	Develop high-value-added insects through genome editing, etc. (Initiative Period: 2025–2035)	Develop low-cost insect feed (Initiative Period: 2022–2040)	–	–	Start a diverse insect farming business in collaboration with Kama City	https://www.kyushu-u.ac.jp/ja/research/close-up/takahiro-kusakabe
	Project C: Sanitary Entomology Goal for 2030: Establish infectious disease measures through the One Health approach in preparation for the next pandemic	Faculty of Agriculture	Associate Professor	Ryosuke Fujita	Isolate, identify, and catalog unknown viruses (Initiative Period: ongoing since 2022)	Develop surveillance and spread prediction systems for insect-borne infectious microorganisms and invasive insects (Initiative Period: 2025–2030)	–	–	–	Work with the Fukuoka Prefecture One Health Promotion Office to address insect-borne infectious diseases	http://www.agr.kyushu-u.ac.jp/lab/lse/wordpress/
	Project D: Psychological Behavioral Research on Eating Insects Goal for 2030: Clarify the psychological mechanisms of eating insects and create insect-based foods that people will feel safe eating on a daily basis	Institute for Asian and Oceanian Studies (Q-AOS)	Associate Professor	Kun Qian	Domestic and international field surveys to understand the reality of eating insects (Initiative Period: 2022–2030)	Uncover psychological and behavioral mechanisms related to eating insects (Initiative Period: 2022–2027)	Create insect-based foods that are pleasant to eat on a daily basis (Initiative Period: 2026–2030)	–	–	Collaborate with relevant domestic and foreign organizations, such as food (and pet food) companies, the AFFIA, the Edible Insect Research Society (shockonken); participate in the ICT-Based Behavior Change Research Unit of the DDIn[2]	https://q-aos.kyushu-u.ac.jp/staff/2241/

Environment and Food

Global Insect Science Research Platform

1960s

- One of the largest insect collections in the world

1st in Japan

2nd among global universities

12th worldwide

Number of samples

- The world's ultimate silkworm bio-resources

Alternative infection and disease models using silkworms, which are easy to breed in large numbers

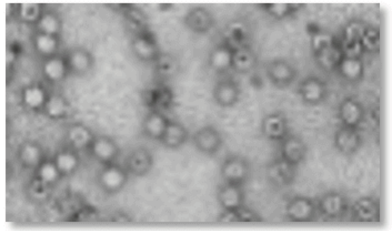
2000s

- Built a strong international network of insect researchers
- Established an insect-farming startup that integrates agriculture, engineering, and economicsaa

Established the university-initiated venture business KAICO LTD.

Established the Insect Science and Creative Entomology Center

2018



Virus-like particles for vaccines mass-produced using silkworm resources

Succeeded in using silkworms to develop a COVID-19 vaccine candidate protein
(Kyushu University Group, June 2020)

Practical application of testing for COVID-19 antibodies
Kyushu University Group x KAICO LTD.
October 2020

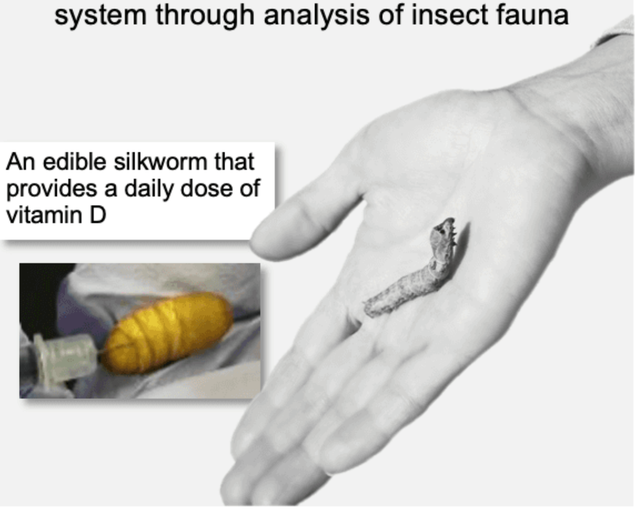
2020

Future Plans

Create new sectors in the insect industry

- 100% domestic vaccine production
- Manufacture in vitro diagnostic agents
- Develop insect-based foods and animal feed
- Develop a biodiversity assessment system through analysis of insect fauna

An edible silkworm that provides a daily dose of vitamin D



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List of Group Initiatives

July 27, 2022

Unit Name: Environment and Food

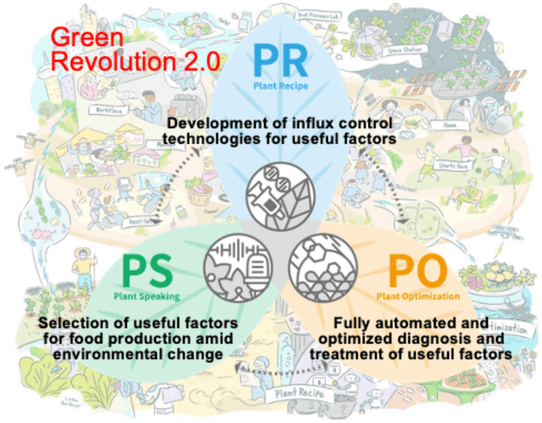
Unit Leader Name: Susumu Fukuda

Group Leader Name: Yushi Ishibashi

Group Name	Goal	Project Manager			Action Item 1	Action Item 2	Action Item 3	Action Item 4	Action Item 5	Collaborations (e.g., Other groups, other units, DDIn^2)	Project URL
		Affiliation	Position	Name							
Agricultural Production Research	Group-wide: Goal for 2030: Build foundational technologies for plant speaking, recipes, and optimization				Explore useful factors related to food production under global environmental change (Initiative Period: 2014–2030)	Develop technologies for introducing and transporting useful factors into crops (Initiative Period: 2020–2030)	Develop automation technology for crop diagnosis and prescription (Initiative Period: 2021–2030)	–	–	While there are currently no partnerships, all projects are capable of collaborating with all other Units and would like to consider a partnership with the DDIn^2.	https://kyudai-crop.com/
	Project A: Crop Science Research Lab Goal for 2030: Establish a seed science center	Faculty of Agriculture	Associate Professor	Yushi Ishibashi	Develop seeds with environmental memory (Initiative Period: 2018–2030)	Develop food production technology using plasma-seed treatments (Initiative Period: 2019–2030)	Create mutant panels of crops with novel functionality (Initiative Period: 2016–2030)	–	–		

Environment and Food

Achieving Green Revolution 2.0 based on next-generation agricultural technologies



Develop new-generation agricultural technologies that coexist with the global environment

2022

Developed new-generation seeds
(Environmental memory, genome editing, etc.)

Searched for key factors contributing to next-generation food production

2025

Develop technologies for introducing and transporting useful factors into crops

Develop new generation of agricultural technology through different fields
(Plasma agriculture, etc.)

2027

Develop automatic technology for crop diagnosis and treatment

Create mutant panels of crops with novel functionality

2030

Establish a seed science center

Centralized management and maintenance of the seeds, seedlings, and breeding and priming technologies that exist at Kyushu University

Production technologies
Smart agriculture, next-generation agricultural materials, etc.

Novel variety cultivation technologies
Genome editing, functionality, etc.

Awakening technologies
Environmental memory, plasma, etc.

Develop technology covering all processes from seed (seedling) production and breeding to crop production that utilizes those seeds

Focused on integrating information on individual plants gained from omics and image analysis with actual production information

Future Plans

New-Generation Agricultural Research

- Organic collaboration with other facilities related to agricultural research (Promoting agricultural innovation)
- Collaboration with other entry points (decarbonization, medical and healthcare)
- Large-scale social implementation using Kyushu University facilities through collaboration with industry and government
- Development of talent familiar with new-generation agricultural technologies

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List of Group Initiatives

July 10, 2022

Unit Name: Environment and Food

Unit Leader Name: Susumu Fukuda

Group Leader Name: Kohei Ohta

Group Name	Goal	Project Manager			Action Item 1	Action Item 2	Action Item 3	Action Item 4	Action Item 5	Collaborations (e.g., Other groups, other units, DDIn[2])	Project URL
		Affiliation	Position	Name							
Aquatic Food Production Research	Group-wide: Goal for 2030: Build a next-generation aquaculture industry				Conduct industry-academia-government collaborations that span from production to distribution, using chub mackerel as a model, such as the project supported by the Cross-ministerial Strategic Innovation Promotion Program (SIP) to develop strategic breeding and production infrastructure for the expansion of fully farmed chub mackerel and overseas exports. (Initiative Period: through 2030)	Develop and implement strategic aquaculture varieties suitable for urban production and a food production system using aquaponics and IoT through a joint industry-academia-government urban aquafarming project (Initiative Period: through 2030)	–	–	–	Promote the digital transformation of biological information and resource circulation related to food production based on advice from the DDIn[2]: formulate production and breeding strategies that respond to climate change based on advice from the Marine Science Research Group; and work with the Aqua-Bioresource Innovation Center in the Faculty of Agriculture to promote research and development in collaboration with researchers from various fields	
	Next-Generation Breeding Project: Goal for 2030: Develop strategic aquaculture species through genome breeding and introduce them into the world	Faculty of Agriculture	Assistant Professor	Tapas Chakraborty	Develop new varieties using genomic information and genome editing (Initiative Period: through 2030)	Develop methods for the preservation and individual regeneration of strains, varieties, and biological resources through reproductive stem cell manipulation (Initiative Period: through 2026)	Develop fertility control methods to prevent spillage of farmed fish and effectively produce the next generation of fish (Initiative Period: through 2028)	Promote branding of genetically modified fish, protect intellectual property, and develop social implementation strategies (Initiative Period: 2024–2030)		Promote certification and branding based on advice from the Functional Food Research Group; and formulate strategies for intellectual property protection and practical application based on advice from the Think Tank Unit and the Open Innovation Platform (OIP)	https://www.agr.kyushu-u.ac.jp/lab/marinebiology/
	Resource Recycling Aquaculture Project: Goal for 2030: Build an innovative aquaculture production system based on resource recycling	Faculty of Agriculture	Associate Professor	Kohei Ohta	Develop feed based on insect, plant, and other materials that do not depend on fish meal derived from natural resources (Initiative Period: through 2030)	Develop sustainable production and utilization technologies for marine invertebrates (such as sea urchins and bivalves), algae, and marine microorganisms (Initiative Period: through 2030)	Develop energy-efficient smart land-based aquaculture and aquaponics systems (Initiative Period: through 2030)	–	–	Develop a natural resource-independent feed production system using insects and plants based on advice from the Insect Foods Group and the Food and Smart Agriculture Group; promote the development of a decarbonization and energy-saving production system based on advice from the Decarbonization Unit; promote the digital transformation of the production system based on advice from the DDIn[2]	https://www.agr.kyushu-u.ac.jp/abric/

Environment and Food

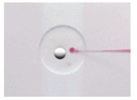
Aquatic Food Production

Promoting comprehensive efforts for advanced research and social implementation

Research and Education | **Proof of Concept** | **Interdisciplinary Collaboration & Collaboration with Industry** | **Future Plans**

Research and Education

Strategic variety development through genomic breeding



- Research on genomic breeding
- Fish stem cell research
- Reproductive engineering research

Innovative production systems based on resource recycling

- Research into the production of invertebrates and algae
- Research into natural resource -independent animal feed
- Research and development of energy-saving inshore aquaculture plants and aquaponics

International research and education

- Center for Promoting International Education and Research of Agriculture
- Institute for Asian and Oceanian Studies (Q-AOS)

Proof of Concept

Aqua-Bioresource Innovation Center Karatsu Satellite
Karatsu City

Fishery Research Laboratory
Fukutsu City

On-campus Farm
Ito Campus

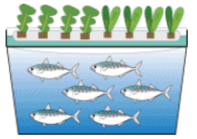
Environmental Control Center for Experimental Biology
Ito Campus

Interdisciplinary Collaboration & Collaboration with Industry

Climate-responsive production and breeding strategies
Environment and Marine Science Research Group

Research on domestically produced genome editing technology
Plant Frontier Research Center

Natural resource-independent feeds such as insects
Insect Science and Creative Entomology Center
Food and Insects Group, Food and Smart Agriculture Group



Decarbonized and energy-efficient production systems
Decarbonization Unit
International Hydrogen Energy Research Center

Value-adding and branding
Functional Food Research Group
Research and Development Center for Five-Sense Devices

Digital transformation of aquatic food production systems
Data-Driven Innovation Initiative

Intellectual property protection and social implementation strategies
Think Tank Unit, OIP

Social implementation
Collaboration with Fukuoka City, Karatsu City, Fukuoka Prefecture and other local governments, fishing cooperatives, private companies, etc.

Future Plans

Strategic variety development and production processes that recycle resources to build a sustainable aquatic food production system and ensure food safety

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List of Group Initiatives

July 8, 2022

Unit Name: Environment and Food

Unit Leader Name: Susumu Fukuda

Group Leader Name: Mitsuru Tanaka

Group Name	Goal	Project Manager			Action Item 1	Action Item 2	Action Item 3	Action Item 4	Action Item 5	Collaborations (e.g., Other groups, other units, DDIn[2])	Project URL
		Affiliation	Position	Name							
Food Science Research	Group-wide: Goal for 2030: Establish foodomics and food DX technologies to evaluate and improve individual safety, security, health, and comfort through comprehensive analysis of factors related to food and health				Establish analytical methods that enable comprehensive and simultaneous detection and evaluation of chemical components corresponding to food and health factors (Initiative Period: 2023–2028)	Develop technology to record, transmit, and reproduce human chemosensory information such as taste, smell, and color that transcends time and space (Initiative Period: 2025–2030)	Develop non-invasive monitoring technology for biological information and health risks, including dietary response (Initiative Period: 2025–2030)	Develop new food design technology that takes into account food preferences and responses by assessing individual sensory responses and health risks of individuals to food (Initiative Period: 2027–2040)	–	Integrate early-stage research seeds and societal needs, actively promoting practical applications and solving societal issues in collaboration with the Open Innovation Platform (OIP); aim for synergy through strengthened cooperation with the Medical and Health Unit	http://www.agr.kyushu-u.ac.jp/lab/foodanalysis/ http://www.rdctos.kyushu-u.ac.jp/index.html
	Foodomics Project Goal for 2030: Establish foundational foodomics technologies that enable comprehensive analysis of food and health factors	Faculty of Agriculture	Associate Professor	Mitsuru Tanaka	Develop technology that enables comprehensive and simultaneous detection and quantification of food components that contribute to taste, aroma, and color and construct algorithms to evaluate and predict human sensory responses (Initiative Period: 2022–2030)	Develop a comprehensive measurement reporting system for metabolome information that reflects biological information and construct algorithms to evaluate and predict biological information and disease risk, including dietary response (Initiative Period: 2022–2030)	Establish quantitative visualization technology for contributing factors related to the food environment, including microbes and freshness, and construct algorithms to evaluate and predict these factors (Initiative Period: 2022–2030)	–	–	Aim to discover unprecedented food science phenomena that surpass human cognitive and analytical abilities by integrating comprehensive component information with data science, such as AI, in collaboration with the Data-Driven Innovation Initiative	http://www.agr.kyushu-u.ac.jp/lab/foodanalysis/ http://www.rdctos.kyushu-u.ac.jp/index.html

Environment and Food

Food Science Research Group: Foodomics Project

Establish foodomics technologies that enable comprehensive evaluation of food quality and health benefit

Achievements to Date

Analytical research for food functionalities

- Anti-hypertensive foods
- Anti-arteriosclerotic foods
- Foods to prevent dementia

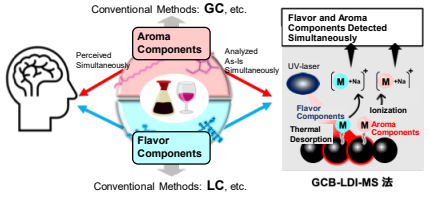
Explored disease biomarkers

- Biomarkers for early diagnosis of hidden diabetes
- Biomarkers for early diagnosis of breast cancer

Innovative technologies for food analysis

- Food ingredient visualization technologies
- Comprehensive detection technologies for color, taste, and aroma components

[Fundamental Technologies]
Multimodal analysis technologies that enable the acquisition of digital information on color, taste, and aroma components



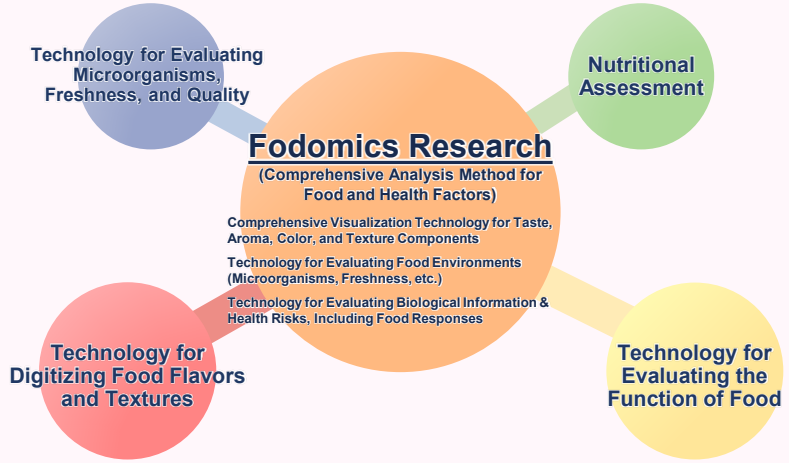
2023 - 2030

Establish analytical methods that enable comprehensive and simultaneous detection and evaluation of chemical components corresponding to food and health factors

Develop technology to record human chemosensory information such as taste, smell, and color

Develop non-invasive monitoring technology for biological information and health risks, including dietary response

Next-generation food science research pioneered by foodomics



Integration of digitalized information for human sensory five senses

Smart food chain

Proposal and provision of delicious and healthy foods

[Collaboration within the University]

Device development and social implementation
- Open Innovation Platform

Medical applications
- Medicine and Health Unit

Data Science and DX
- Data-Driven Innovation Initiative

[External Collaborations]

[Academia]	• Food-related academic societies • Medical and nutrition-related academic societies • Data science-related academic societies, etc.
[Government]	• National Agricultural Research Organization (NARO) • National Institute of Advanced Industrial Science and Technology, etc.
[Industry]	• Food-related companies • Pharmaceutical and diagnostics-related companies • Data science-related companies, etc.

Future Plans

Develop new food design technology that takes into account food preferences and responses by assessing individual sensory responses and health risks of individuals to food

Promote advanced food science research based on foodomics and food DX

<Goals>

Based on the 2050 Carbon Neutral Declaration:
- **Strategy for Sustainable Food Systems, MeaDRI**

Aims of the 6th Science, Technology, and Innovation Basic Plan:
- **Society 5.0**
- **SDGs**

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