UTSIP Kashiwa 2024　Program A

Host Laboratory List

Division of Transdisciplinary Sciences

- Complexity Science and Engineering (CSE)

Division of Environmental Studies

- Ocean Technology, Policy, and Environment (OTPE)
- Environment Systems (EnvSys)
- Human and Engineered Environmental Studies (HEES)
- Graduate Program in Sustainability Science - Global Leadership Initiative (GPSS)

Division of Transdisciplinary Sciences

Department of Complexity Science and Engineering

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Aoki's Laboratory	Lecturer AOKI Shohei	How does a habitable planetary climate make and sustain? To answer this question, it is important to investigate the atmospheres of Mars and Venus that are "Earth-like planets" in our solar system. More than 90% of the atmospheric constituents of Mars and Venus are CO2, and the abundances and variations of trace gases (such as water vapor, CO, CH4, HCl, SO2, H2O2, OCS, etc) and isotopic ratios (D/H, 13C/12C, 18O/16O, etc) of the atmospheric species are the keys to understand chemistry, physics, and evolution of Mars and Venus. We have employed new remote-sensing spectroscopic observations to investigate these atmospheric markers with European space missions such as Mars/Venus Express and ExoMars Trace Gas Orbiter, and ground-based/space-borne telescopes such as Subaru, SOFIA, ALMA, IRTF, JWST, and HST, to understand chemistry, physics, and evolution of Mars and Venus atmospheres.	Planetary Science; Mars; Venus; Remote Sensing; Atmospheric Science	Analysis of Mars/Venus spectra taken by telescopes/spacecraft (below is just a few examples and the actual projects may be decided flexibly). (1) Hydrogen peroxide (H2O2) on Mars: An important unsolved problem in planetary science concerns the long-term stability of the Martian CO2 atmosphere. Solar UV light would rapidly destroys CO2 into CO and O2, which is not observed. Odd hydrogen (HOx) species that result from photolysis of water vapor, may act as a catalyst for recombination of CO2. However, HOx species were never directly observed on Mars. H2O2 is a stable, abundant reservoir species of HOx and thus holds the key to constraining HOx abundances. In this project, students will analyze the mid-infrared spectra taken by a ground-based telescope to investigate seasonal and spatial variation of H2O2 and to tackle the atmospheric stability problem. (2) Carbonyl sulfide (OCS) on Venus: Despite recent advances in the Venusian atmospheric study, the atmospheric chemistry and the efficiency of vertical atmospheric diffusion at the cloud-top altitudes are still poorly understood. OCS abundance at the cloud-top can be a key diagnostic to these missing knowledges. Measuring day to night variation of OCS abundances at the cloud top is indispensable to quantitatively constrain the eddy diffusion coefficient and diurnal photochemical processes of sulfur-carbon cycles. In this project, students will analyze near-infrared spectra taken by a ground-based telescope, which is able to measure OCS abundances both on dayside and nightside of the Venus cloud-top for the first time.

Division of Environmental Studies

Department of Ocean Technology, Policy and Environment

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Ocean Resource and Energy Laboratory	Assoc. Prof. Shinichiro Hirabayashi	Developing new types of resources and energies that reduce global warming and minimize negative environmental impact is a key issue in establishing a sustainable society. The ocean provides such opportunities. The development of ocean renewable energy sources such as offshore wind, ocean current, thermal, wave, and solar energies is one of the areas of our research. In addition, we are conducting research on the development of platform technologies, including floating platforms, station-keeping systems, and materials. Main areas of laboratory research are (1) ocean renewable energy, (2) floating structure design and its motion, (3) maintenance technology for underwater structure, and (4) ocean space utilization for storage and transportation.	Ocean renewable energy, floating offshore wind turbines, ocean space utilization, floating systems, flow-structure interaction	We have a variety of research topics related to ocean renewable energy and floating platform technologies. The applicant can choose what they want to do after acceptance through discussions. Some examples we can offer are the design of novel energy-harvesting systems, measurement and analysis of the dynamic response of floating platform, development of effective wave absorbing systems, and measurement of wave/vortex field around a floating body. Experiments will be done in the water channel in our laboratory.

Division of Environmental Studies

Department of Environment Systems

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Energy and Environment Laboratory	Lecturer AICHI Masaatsu	Current approaches to energy supply and consumption face problems such as climate changes and dwindling resources. The development of key technologies for saving energy, switching to renewable energy resources, and appropriate waste disposal is required. Our goal is to perform research that will contribute to the development of these technologies, especially by taking advantages of the characteristics of subsurface formations. For example, we study ways of developing a sustainable energy system, especially through hydrogeological and thermo-poro-mechanical modeling of geothermal heat pumps, geothermal power plants, and the geological sequestration of carbon dioxide. On the other hand, we also start to study how to adapt to global warming. Combining mitigation and adaptation is an attractive choice but it is not simple because one countermeasure possibly causes another environmental effects. For example, though the groundwater becomes more important water resource under changing climate, the overexploitation of groundwater possibly causes another environmental problem such as land subsidence, sea water intrusion in coastal area, so on. We try to predict and prepare for this kind of domino-like propagation to other environmental problems in advance.	subsurface resource; land subsidence; numerical modeling; anomaly detection; uncertainty analysis	Detection of the start of plastic land subsidence from time series monitoring data Subsurface fluid resources such as groundwater, natural gas, etc., are important for our societies. On the other hand, land subsidence caused by subsurface fluid abstraction has been one of the severe environmental problems. It is important to avoid the land subsidence problems for the subsurface resource production to be sustainable. The subsurface formation elastically deforms under small disturbance while the plastic deformation occurs if the load exceeds the yield stress. Then, controlling the abstraction rate so that the effective stress does not exceed the yield stress of geological formations is important. However, it is difficult practically because of the limitation of our knowledge on subsurface structures. One of the possible ideas is a monitoring-based approach to check whether the plastic deformation occurs or not and stop the production before the land subsidence becomes large. The research questions concerning this idea are what kind of and how accurate monitoring system is required, and how we can detect the elastic-plastic transition from the monitored data. In this theme, we tackle these questions with numerical simulation and the time series data analysis and/or deep learning approaches.
Akizuki Laboratory	Assoc. Prof. AKIZUKI Makoto	“Supercritical water” refers to a water whose temperature and pressure are above critical point. Water near and above critical point offers dramatic physical changes depending on the operating conditions. In particular, the ionic content and dielectric constant of water changes extensively based on temperature and/or pressure. As a result of this, it becomes possible to select a reaction based on one’s objective: from an ionic atmosphere suitable for acid/base reactions, to one implementing the dissolving of organics, which is equivalent to a non-polar solvent. Taking advantage of these properties, it is expected that this new, inexpensive, environmentally-friendly reaction medium will replace conventional organic solvents. Our laboratory has many research goals, covering a broad range of topics: Organic synthesis without catalyst or using solid catalysts, degradation of wastes by supercritical oxidation reaction, and synthesis of metal oxide nanoparticles. In regard to all of these fields, by designing, analyzing, and controlling reactions based on a study of chemical reaction rate and reaction engineering, we are advancing extensive research, from fundamental research related to the chemical reaction in sub- and supercritical water, to the development of new engineering applications.	Supercritical Water, Reaction Engineering, Organic Synthesis, Catalysis, Nanoparticle synthesis	Supercritical water is a promising reaction medium for such as organic synthetic reactions and inorganic nanoparticle synthesis because its solvent properties can be varied with the temperature and the pressure, and these properties affect reaction kinetics and mechanisms. In this project, we will investigate how the reactions in supercritical water can be controlled with the change of temperature and pressure of supercritical water and how this reaction control affects the yield and properties of products.

Oshima Laboratory	Prof. OSHIMA Yoshito Dr. NEZU Yukiko	In university experimental research, carrying out research safely without losing research creativity and activities is a difficult proposition because research promotion and its risks are inextricably linked. When considering the safety of an academic laboratory, it is important to view the laboratory as a system that consists of human behavior, the transportation of things, and the conditions of the experimental research field, and to analyze this system by acquiring data through scientific methods from actual experimental research sites. Some of the most significant data gathered include tracking the flow line of an experimenter's movement, the usage of chemical reagent bottles, and the distribution of chemicals induced by indoor airflow. The collected data is then integrated and analyzed by a deep learning method as means of investigating the system configuration of laboratory which enables us to objectively and quantitatively understand the conditions of experimental sites and the characteristics of their research. "Laboratology" is a new concept area that is being proposed for future research. Laboratory safety must be discussed more scientifically and quantitatively. Undoubtedly, this concept will contribute to comprehending the characteristics of various research activities more precisely and help facilitate discussing risk assessment of laboratory experiments.	Laboratory safety; Visualization; Airflow analysis	Laboratories are workplaces in which complex airflows are formed, primarily due to the simultaneous and arbitrary work of many experimenters acting according to different experimental purposes and plans. Such complex airflows may inadvertently expose experimenters to hazardous and potentially toxic chemicals and fumes in laboratories. To prevent such exposure, the dynamics of the airflow in the laboratory need to be precisely analyzed. In this project, you will conduct airflow analyses in university laboratory by Particle Image Velocimetry (PIV) analysis and Computational Fluid Dynamics (CFD) simulation. PIV is an optical method of flow visualization used to obtain the velocity of fluids, while CFD is a system that uses numerical analysis to analyze and work out complications concerning fluid flow with the aid of computer-based simulation. Using these techniques, you will investigate the air environment in the laboratory in view of an outlet/inlet ventilation layout and experimenter movement.
Geosphere Environment Systems Laboratory	Prof. TOKUNAGA Tomochika	Underground geosphere environment has been extensively used to support highly developed human society; e.g., extraction of energy resources and groundwater, waste disposal, construction of tunnels and underground spaces. Because of these activities, environmental problems which affect the sustainability of our society have emerged. The target of our laboratory is to understand and predict the change of geosphere environment caused by human activities, and to develop necessary engineering measures to attain sustainable use of geosphere environment. Current research topics include, studying and evaluating geosphere environmental changes caused by energy resources development and proposing necessary technological measures for sustainable resources development, securing stable and safe freshwater resources and development of efficient management schemes, and modeling long-term fluid flow and material transport processes through geosphere and its application to waste disposal and energy resources exploration.	Groundwater; coastal zone; seawater intrusion; modeling; field survey	Fresh groundwater in shallow unconfined aquifers is an important water resource for many coastal zones worldwide which, however, is threatened by seawater intrusion. The occurrence of seawater intrusion is controlled by both anthropogenic activities and natural factors. Anthropogenic activities such as land reclamation, abstraction of freshwater and other natural resources, construction of structures such as riverbanks and ditches, and alternation of land surface conditions, could disturb freshwater-seawater interactions from the natural conditions. To what extent seawater intrusion occurs is also dependent on natural factors such as aquifer properties, tidal river dynamics, and meteorological conditions. In this study, computer-based techniques such as numerical modeling combined with field-based geophysical exploration techniques such as 1D and 2D resistivity surveys will be applied to understand seawater intrusion situations both from conceptual cases and realistic sites. Students will learn fundamental knowledge of coastal hydrological processes and gain the ability to analyze environmental issues through hands-on practice of using advanced modeling tools as well as participating field investigation. Also, students will have chances to get involved in other research activities in this laboratory, such as GIS-based mapping, water sampling, and water quality analysis.

Division of Environmental Studies

Department of Human and Engineered Environmental Studies

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Laboratory for Intelligent Systems Design	Prof. HIEKATA Kazuo	Societies and industries can be thought as a system of people, technology, and institutions. Although these social and industrial systems have evolved and met the high expectations of humans, the mechanisms of the systems have become more complex, giving rise to difficult problems to solve, such as global warming and aging populations. This laboratory is engaged in research that contributes to solving such problems by supporting human intellectual activities such as decision-making related to systems with simulation, sensing, and data analysis technologies.	Multi-agent simulation; Model-based design; Maritime Transportation; Decarbonization	We evaluate multiple policy options for decarbonization of International Maritime Shipping. Since the optimal behavior of one shipping company changes depending on the behavior of another, top-down simulations cannot accurately predict the future CO2 emissions. The internship student will customize and develop a multi-agent simulation program for the quantitative evaluation of multiple policy options. In the internship, we will explore better policy options for accelerating decarbonization based on the simulation results.

Division of Environmental Studies

Graduate Program in Sustainability Science – Global Leadership Initiative

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Sustainable Society Design Center	Prof. KAMEYAMA Yasuko	My research activity covers wide range of climate change mitigation policies' policy making and policy introduction. Among those policy options, policies that stimulate voluntary actions of business sector is becoming important. Carbon pricing, including carbon tax, emissions trading scheme and Carbon Border Adjustment Mechanism (CBAM), is one of those that are becoming increasingly popular. It is also important to focus on business sectors' alliances and initiatives that could make great changes in our society. My laboratory wish to continue making a thorough assessment as to what kind of policies, or what type of voluntary initiatives of non-state actors, could be most effective in reducing GHG emissions, while caring for other aspect of sustainability such as social justice and equity.	climate change, emission reduction, security, trade	Anything related to following themes can be acceptable: 1. Greenhouse gas emission reduction policy assessment, countries' options to reach net-zero emission by 2050 2. Climate and security, including relationship between climate change and national security, and people's displacements 3. Trade and climate change