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
Ozaki Laboratory	Prof. Masahiko OZAKI, Asst. Prof. Ryota WADA	Carbon capture and storage (CCS) is a critical component to meet the ambition of the Paris agreement. To overcome Japan's geological constraints, we proposed the concept of offshore CCS system using sub-seabed geological formation and shuttle ship transfer. The project, supported by the Ministry of Environment, is expected to start demonstration project soon. Our research area covers architectural design of the concept, feasibility study, design of critical offshore structures, optimization of logistics system and so on. The expertise of our laboratory is design of offshore systems with emphasis on implementation to the real world. Our research fields are ocean engineering and data-driven approach. The concept provides flexibility and scalability to CCS systems and will accelerate the introduction of CCS over the globe for a sustainable future.	Carbon capture and storage Offshore; Systems engineering; Feasibility study; Ocean engineering	As the concept of offshore CCS is still at its development phase, we foresee many other innovative concepts that are worth further investigation. The role of summer program student is to explore the broad solution space of CCS concepts. Some ideas of the concept are utilization of carbon dioxide (known as CCUS, Carbon capture utilization and storage), or combining CCS with other offshore technologies (e.g. offshore wind, methane hydrate). The student is free to choose from his own interest. The research will be conducted with the frame work of System Engineering. Domain specific knowledge will be provided by the lab members, although we encourage the student to study the fundamentals of CCS. If the student has some specific interest based on his/her background, we are happy to link that with CCS to come up with a new research project.
Ocean Environment Modelling Laboratory	Prof. Toru SATO	Our researches are aimed to form concepts of environmentally harmonizing systems, which coexist with natural environments for the global sustainability. For this purpose, we are developing computational models of environments using physics, chemistry, and biology, etc. Then these models are synthesized into simulation systems in order to predict environmental impacts and construct public acceptance. Our research interests are environmental impact assessment of CO2 storage in subsea underground, biological CO2 fixation, formation and dissociation modelling of methane hydrate, CO2 geological storage by hydrate, development of multi-scale ocean model, modelling of flashing light effect of photosynthesis and the effects of CO2 on marine biota.	Gas hydrate formation; Phase-field model; Gas hydrate distribution; Sand sediment	Methane hydrate is considered as a promising energy resource for the near future. To predict the gas productivity from the methane hydrate in the subsea sand-sediment, it is important to know absolute permeability accurately of the sediment bearing methane hydrate. Hence, the hydrate morphological distribution: namely, what is the shape and morphology of hydrate, in the sediment should be elucidated, because the permeability is strongly affected by the hydrate distribution. In this study, to know where hydrate is formed in the pore of porous media, we propose a numerical model for estimating the microscopic distribution of methane hydrate in sand sediment, using the

				phase-field model, which provides the mobility of the front of the hydrate formation. Using this numerical model, many cases of hydrate formation and water flow will be numerically simulated within the microscopic computational domains.
Ocean Resource and Energy Laboratory	Assoc. Prof. Shinichiro HIRABAYASHI	Developing new types of resources and energies that reduce global warming and negative environmental impact is a key issue to establish a sustainable society. The ocean provides such opportunities. Development of ocean renewable energy such as offshore wind, ocean current, thermal, wave, and solar energies is one of the areas of our research. In addition, research on development of platform technologies such as riser, floating platform, station keeping and materials are investigated. Main areas of laboratory research are (1) ocean renewable energy, (2) development of ocean natural resources, (3) CO2 ocean sequestration, (4) ocean space utilization for transportation, and (5) storage of resources in the ocean.	Ocean renewable energy; floating offshore wind turbines; ocean space utilization; floating systems; ocean natural resources; flow-structure interaction	We have a variety of research topics related to ocean renewable energy and ocean natural resources. The applicant can choose what he/she wants to do after acceptance through discussions. Some examples we can offer are the design/manufacture of novel floating wind turbines, measurement and analysis of the dynamic response of floating platform, development of effective wave absorbing systems, design of novel energy-harvesting systems, and measurement of wave/vortex field in the wake of a floating body. Experiments will be done in the water channel in our laboratory.
Waseda Laboratory	Prof. Takuji WASEDA	The following research activities are on-going: i) waves in the ice-covered sea; ii) freak waves under storm; iii) Stereo-imaging of ocean waves; iv) high-resolution coastal wave, current and wind modeling and observation for assisting marine sports. In the first project, we are extensively studying wave-ice interaction in the Arctic Ocean. Wave buoys were deployed in 2016 and also in 2019. Historical and future events are studied as well. In the second project, numerical simulations of waves under typhoon and bomb cyclone are conducted to identify dangerous seas where the freak wave occurrence is high. In the third project, a field observation is conducted using stereo photogrammetry from an ocean tower to reconstruct 3D surface wave geometry. We plan to extend this method to be used on board the ship. In the fourth project, aiming for the 2020 Olympic game, we are constructing a data base for the sailing competition. The overall activities in our group encompasses theoretical, observational and numerical studies of ocean waves, currents and wind. The acquired	Ocean waves; freak wave; marine wind; marine renewable energy; stereo photogrammetry	The student will engage him/herself in a self-motivated research project that includes but is not restricted to the research topics listed above. The research may involve analyses of ocean satellite image, observation data and model outputs. Those motivated can challenge in programming the numerical model and analysis program as well. The research will be guided by postdoctoral researchers, graduate students, Assistant Prof. Kodaira and Prof. Waseda. Regular meetings will be held in English. The past UTSIP students undertook the following research topics: developing phase resolved nonlinear wave model based on High-Order Spectral Method; Synthetic Aperture Radar image analysis for ocean waves; assessment of wave power considering the performance of Wave Energy Converter; optimization of sail assisted ship navigation; freak wave occurrence near Japan; Arctic cyclone climatology. The student with prior programming knowledge with Matlab, Python, C,

		knowledge will be applied to the developments of the Northern Sea Route, safe navigation and operation at sea, and marine renewable energy.		Fortran 90, GrADS, etc. may have an advantage undertaking the project, but, the senior students will guide those who do not have any experience. The research topics can be determined upon discussion with Prof. Waseda prior to the visit to Japan via e-mail exchange. We are happy to host those who are interested not only in research but also in learning about Japanese culture.