UTSIP Kashiwa 2024 Program A

Host Laboratory List

Division of Transdisciplinary Sciences

- Advanced Energy (AdvEng)
- Complexity Science and Engineering (CSE)

Division of Biosciences

- Integrated Biosciences (IB)
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Division of Environmental Studies

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

Division of Transdisciplinary Sciences

Department of Advanced Energy

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Ono-Inomoto-Tanabe Laboratory	Prof. ONO Yasushi Dr. INOMOTO Michiaki Dr. TANABE Hiroshi	Our main research fields are Plasma Physics and Engineering, especially development of fusion energy, alternative energy sources, space and solar plasmas and plasma applications. The present fusion research already realized fusion power output larger than the input power as an exhaustless energy without any global warming gas. Its key question is whether we can develop cost-effective /high-beta confinement using economic high-power heating, where the beta is the plasma thermal pressure P confined by the unit magnetic field: beta=P/(B^2/2μ_0) ~ fusion output power / coil cost. We have developed a number of new ideas for (1) high-power heating: merging/ reconnection heating and (2) ultra-high-beta confinements: second-stable Spherical Tokamak (ST) , using the TS-3, TS-4, TS-6, UTST and MAST, ST-40 devices (based on UK-Japan collaboration). Since the magnetic field-line reconnections (mergng of two ST plasma) converts about half of poloidal (reconnnecting) magnetic energy into plasma kinetic/ thermal energy, our TS-3 and ST-40 experiments documented significant ion heating over 2.3keV. We found the new scaling law of reconnection heating energy proportional to square of reconnecting magnetic fiels B_rec, indicating that the high-B_rec ST merging will heat ions to the burning plasma regime without using any additional heating facility line neutral beam injection (NBI). This fact leads us to new high-magnetic field ST merging/ reconnection experiments TS-6 with B_rec > 0.3-0.5T for ion heating >1keV. We are now organizing the international world-wide reconnection collaboration program CMSO for physics, application of merging and reconnection and also for international and interdisciplinary plasma education of young scientists among MRX (Princeton U.), MST (Wisconsin Univ.), MAST (Culham lab.) and ST-40 (Tokamak Energy Inc). I. ■ Web：http://tanuki.t.u-tokyo.ac.jp/	Plasma Experiment; Fusion Energy; Laboratory Astrophysics; Magnetic Reconnection; Spherical Tokamak (ST); Magnetic Self-Organization	We, international plasma research groups composed of Univ. Tokyo, Princeton Univ, NIFS, JAXA etc. are planning annual interdisciplinary schools and workshops of plasma astrophysics in 2024 using bidirectional exchanges of research staffs, graduate and undergraduate students. This new approach focuses on interrelationship of laboratory plasma experiments, space/ astrophysical plasma observations and numerical/ theoretical plasma studies and their applications based on the international and interdisciplinary collaborations. Our annual school and workshop will be held in Tokyo area for graduate and undergraduate students. Mutual visits of faculty members and graduate and undergraduate students will be encouraged and realized. Our initiative will provide a new interdisciplinary and balanced education of plasma astrophysics in both the undergraduate and the graduate schools. This program involves laboratory experiments, space observations and numerical / theoretical studies of plasma astrophysics. Our activities will generate a joint consortium of departments of advanced energy, space-astrophysical science, physics and electrical engineering. We believe that our annual school and workshop will provide new opportunities of international and interdisciplinary lectures, discussions and experiments to all plasma-course students.

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 CO_2, and the abundances and variations of trace gases (such as water vapor, CO, CH_4, HCl, SO_2, H_2O_2, OCS, etc) and isotopic ratios (D/H, $^{13}C/^{12}C$, $^{18}O/^{16}O$, 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 (H_2O_2) on Mars: An important unsolved problem in planetary science concerns the long-term stability of the Martian CO_2 atmosphere. Solar UV light would rapidly destroys CO_2 into CO and O_2, which is not observed. Odd hydrogen (HOx) species that result from photolysis of water vapor, may act as a catalyst for recombination of CO_2. However, HOx species were never directly observed on Mars. H_2O_2 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 H_2O_2 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 Biosciences

Department of Integrated Biosciences

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Laboratory of Signal Transduction	Assoc. Prof. SUZUKI Kuninori	"The budding yeast Saccharomyces cerevisiae is a very attractive model organism for studying the fundamental theories and concepts of eukaryotic cells. We applied the power of yeast genetics to understand many aspects of yeast cells. Our current research is mainly focused on (1) molecular mechanism of autophagosome formation using live imaging techniques, (2) molecular mechanism of autophagic body degradation by biochemistry, (3) screening of new membraneless organelles, and (4) analysis of intracellular phospholipid dynamics. (1) Autophagy is a major pathway of bulk degradation of cytoplasmic materials. In yeast, autophagy has been studied as a cellular response for survival during nutrient-limited conditions. During autophagy, cytoplasmic components are enclosed in a membrane compartment, called an autophagosome. We have been studying the molecular mechanism of autophagosome formation by live imaging and quantitative analysis of microscopic images. (2) The autophagosome fuses with the vacuole, to become an autophagic body. The cytoplasmic components to be degraded are sequestered from the hydrolytic enzymes in the vacuolar lumen by the autophagic body membrane. Thus, degradation of the autophagic body membrane is necessary for proteolytic enzymes to access the cargoes of the autophagic body. We are trying to elucidate the molecular mechanism of autophagic body membrane degradation by biochemical analysis. (3) Nucleolus is a membraneless organelle that has been known for a long time. Recently, membraneless organelles have become known not only in the cell nucleus but also in the cytoplasm However, no comprehensive screening has been performed so far. We have screened novel membraneless organelles from a unique viewpoint. We have been analyzing the obtained candidates using bioimaging techniques. (4) Phospholipid is a main component of biological membranes. Recent studies have shown that phospholipids dyamically traffic between membrane organelles via membrane contact sites. We are analyzing phospholipid dynamics using a fluorescent probe which we have found and biochemical methods. Our ultimate goal is to draw a comprehensive map for phospholipid dynamics in eukaryotic cells."	autophagy; cell biology; live imaging; membraneless organelles; organelles	(1) Live imaging of autophagosome formation by fluorescence microscopy. (2) Analysis of phospholipid transfer from the endoplasmic reticulum to autophagosome membranes by FRAP (fluorescence recovery after photobleaching) analysis. (3) Analysis of the autophagosome formation process by deep learning. (4) Morphological classification of autophagosome formation by multivariate analysis of high-dimensional morphometric data. (5) Molecular analysis of domains of the yeast vacuolar phospholipase Atg15. (6) Live imaging of autophagic body degradation by fluorescence microscopy. (7) Biochemical analysis of autophagic body degradation by biochemistry. (8) Live imaging of membraneless organelles by fluorescence microscopy. (9) Regulation of the formation of membraneless organelles by chemical reagents and temperature changes. (10) Live imaging of lipid dynamics using a fluorescent probe. (11) Analysis of phospholipid dynamics by thin-layer chromatography.

Division of Biosciences

Department of Computational Biology and Medical Sciences

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Frith Laboratory	Prof. FRITH Martin	Our aim is to find interesting and useful information in genetic sequences, and to develop algorithmic and mathematical methods for this purpose. We recently discovered the oldest ever "protein fossils": segments of formerly protein-coding DNA, by sensitive probability-based analysis. This revealed a great diversity of transposable elements in vertebrate ancestors of the Paleozoic Era. We also collaborate with medical geneticists to understand complex chromosome rearrangements and tandem repeat expansions / contractions that cause disease. We discovered the cause of neuronal intranuclear inclusion disease: a tandem repeat expansion in a human-specific gene. In related work, we have detected recombination events between LINE and SINE repeat elements, showing that recombination of repeat elements generates somatic complexity in human genomes. Another project found significant non-existence of sequences in genomes and proteomes, providing clues about immune recognition and pathogen/host adaption. Finally, we are developing a mathematically-optimal way to sample big sequence data, so it can be analyzed quickly, based on minimally-overlapping words.	Genome; evolution; probability; algorithms	Students are encouraged to pursue their own ideas on analyzing genetic sequences. There are broadly two types of project: biological investigation, and method development. Examples of biological investigation: survey the evolution of gene structure by gain or loss of splice sites, frameshifting, gene fusion or fission, etc; compare the evolution of mitochondrial versus plastid genomes; compare genome evolution to major body-form evolution (e.g. snakes, whales). Examples of method development: make a sensitive probabilistic model for finding distantly-related DNA sequences; devise a beautiful way to visualize complex sequence rearrangements; develop a way to extract specific rearrangement events from pair-wise alignments of long sequences (e.g. long DNA reads or whole genomes).

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 Environmental Modelling Laboratory	Prof. SATO Toru	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 CO2 storage in the deep ocean and in subsea underground, biological CO2 fixation, formation and dissociation of methane hydrate, CO2 geological storage by hydrate, the effects of CO2 on marine biota, and offshore recovery of floating marine plastic debris.	Carbon capture and storage; CO2 hydrate; Numerical simulation; Sub-seabed; Geological formation	CO2 capture and storage is a promising strategy against global warming. Although there is concern about the risk of CO2 leakage from deep saline aquifers, it is expected that CO2 hydrate formation suppresses the leakage in the sub-seabed sediment, depending on the water depth of a storage site. Therefore, hydrate formation in the sub-seabed sand sediments is one of key factors in lowering the risk of CO2 leakage and it is important to know conditions under which CO2 leakage is suppressed by hydrate formation. To estimate the sealing effect of CO2 hydrate against CO2 leakage beneath the seabed, a numerical simulation method of hydrate formation in sand sediments can be a useful tool. In this project, numerical simulations will be conducted using an existing code to investigate condotions under which CO2 hydrate is safely formed and performs a proper sealing effect.
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
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
Simulation of Complex Systems Laboratory	Prof. CHEN Yu	A wide range of research topics are studied in our lab, including social-economics, complex fluids, and biological systems. There are three main research directions: (1) Multi-agent cooperative evolutionary games for modeling and simulations of financial markets; (2) Discrete kinetic models for simulation of complex fluids; (3) Cellular automata and heterogeneous stochastic agent models for simulations of cancer and aging.	Complex Systems; Agent-Based Modeling; Stock Price; Aging; Tumorigenesis	As part of the program, a student will be assigned a small project, involving model construction and computer simulation. The specific complex system for study will depend on the student's interest. A financial market, a solution containing colloid, or a growing tumor could be studied. Apart from research, visits to related laboratories at other universities, and/or scenic sites surrounding Tokyo, etc., will also be scheduled.
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

Department of Socio-Cultural Environmental Studies

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Jun SASAKI (Estuarine & Coastal Environment) Laboratory	Prof. SASAKI Jun	We focus on estuarine and coastal environmental studies in the field of civil, coastal, and hydro-environmental engineering: (1) Numerical modeling and application of physical and biogeochemical processes in estuarine and coastal waters. (2) Environmental restoration in urban bays. (3) Mitigation of and adaptation to climate change, including evaluation of carbon removal by blue carbon ecosystems. (4) Coastal disaster mitigation. (5) Sustainability of community and livelihood in coastal areas in developing countries. Tokyo Bay is one of our main study fields at a short distance from our campus. The bay has suffered from a decline in fishery and water quality, including hypoxia and anoxia, for a long time. We have been considering strategies for environmental restoration, rehabilitation, and mitigation in the bay supported by scientific rationale. Disaster mitigation against storm surges and tsunamis is also our research target, including developing and applying prediction systems for coastal hazards using open-source numerical models. Our focus is also on coastal zone management for sustainability in developing countries, especially in mangrove areas influenced by climate change and associated (relative) sea level rise.	Coastal engineering; numerical simulation; water quality and ecosystems; blue carbon; storm surges	Students will first study physical and biogeochemical processes in estuarine and coastal waters, including coastal circulation, water quality and ecosystems, and sedimentary processes. Secondly, students will choose one of the related problems and learn its mechanism by applying a numerical model. Students will also learn skills in pre-processing and post-processing for numerical computation using Python tools and/or Matlab. Students may select an open source model, e.g., FABM-ERSEM and FVCOM. Students will plot results, interpret them, and present their works and outcomes at the lab's progress report session. Students interested in estuarine and coastal engineering and numerical computation are welcome. Students are expected to have basic IT skills, such as programming in Python and working on Linux.

Division of Environmental Studies

Department of International Studies

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Honda Laboratory	Prof. HONDA Riki	Our society is exposed to various types of risks including natural disasters. Preparation for such risks is essential, but no countermeasure can provide perfect protection against severe disasters. In the presence of various threats such as climate change, huge earthquakes and tsunamis, society needs to be endowed with capability of adaptation and resilience. In our group, mechanism of collective behavior observed in the society coping with the situation with severe uncertainty is discussed from the viewpoints of social networks, game theory, adaptive systems theory, etc. Innovative mathematical approach for uncertainty management, such as financial problems is also in our scope. Development and management of infrastructure systems, advanced design methods, asset management and international technology transfer are also of our interest.	Infrastructure; community resilience; disaster management; information theory; machine learning	(1) To discuss how community's attitude for disasgers is developed, statistical analysis of survey data using Bayesian approach or social network analysis will be conducted. (2) To explore the methodologies for siismic design/infrastructure maintenance, machine learning and information theory based approch will be conducted.

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