Data for Self-Assessment and External Review

Department

January 10-11, 2013

Department of Earth and Planetary Science

Graduate School of Science

The University of Tokyo

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I. Introduction

1. Basic Principles and Objectives of Education and Research at the Department

(1) Basic Principles of Education and Research at the Department of Earth and Planetary Science

The Department of Earth and Planetary Science sets its educational and research objectives to exploring the origin and evolution of the earth and planets, their surface environments, and lives living there, as well as understanding physical and chemical processes which control various phenomena arising from various parts of the earth and planets. Such phenomena occur in a wide range of time and spatial scales, within a complex system of the earth and planets in the form of interactions among different subsystems. In order to comprehend such phenomena, it is indispensable to narrow down the target phenomena and promote their better understanding, and at the same time, to integrate them and obtain the comprehensive view. Based on such principles, the department is divided into five groups: four target-based groups and one group aimed for integration. Space and Planetary Science group studies planets and satellites constituting the solar system and planetary space. Atmospheric and Oceanic Science group studies 'fluid earth' including ocean and atmosphere. Solid Earth Science group studies 'solid earth' including the earth's crust, mantle and core. Geosphere and Biosphere Science group studies biosphere that extends along the boundary between the solid and fluid parts of the earth, and its evolution throughout the history of the earth. Lastly, Earth and Planetary System Science group aims to understand interactions among those subsystems on various temporal and spatial scales to comprehend their behaviors integrally as a unified system. Methods employed for researches in the department have large variety. The methods include field survey and observation that are essential to quantitatively comprehend diversity and complexity of the phenomena, laboratory experiment, analysis and theory that are indispensable to extract universality from the observed diversity and complexity, and modeling and simulation that are necessary to acquire the comprehensive view of the phenomena. Each group conducts education and research by making full use of these diverse research methods while collaborating closely with each other through their boundary regions.

(2) Educational Objectives of the Department

Educational objectives of the graduate programs at the Department of Earth and Planetary Science are to foster researchers with broad perspectives, deep expertise, international sense and creativity, as well as to train science engineers who can satisfy various social demands through wide and firm technical knowledge. Expansion of the target fields of research in earth and planetary science is crucial to comprehend the earth as a system that is composed of the solid earth, its surface environment and surrounding planetary space that interact one another in a complicated fashion, and to treat its history of formation and evolution as well as its future behavior as a temporally sequential manner. The target fields of earth and planetary science can be expanded in two ways. One is to make an action promptly to the rapid growth of relevant scientific technology, and the other is to respond to social demands more than ever. The first approach requires to keep providing scientists, who have highly sophisticated knowledge and ability in the fields of earth and planetary science and have vitality to appeal their activities in international community. On the other hand, it is indispensable to foster scientists with high level of expertise and broad perspectives in order to develop our research areas through maintaining closer relationship with human society and to satisfy its demands. Graduate program of the department is large enough to bring up such two types of personnel, so we recognize that achieving these two educational objectives is the task of our research

fields.

Educational objective of the undergraduate programs is to let students learn basic concepts, knowledge and methods of the earth and planetary science. In order to teach fundamental knowledge on highly diversified earth and planetary science, two undergraduate programs are maintained based on two different disciplines. Educational objective of Earth and Planetary Physics Program is to let students learn basic knowledge in physics and applied mathematical sciences. Educational objective of Earth and Planetary Environmental Science Program is to let students learn how to observe substances of the solid earth and planets, their surface environments and lives living there, and to learn how to reconstruct their evolutional processes and their formation conditions. While both undergraduate programs have curriculums that put emphases on understanding of basic principles and knowledge and acquiring skills on observation and computation, relative weights of emphases are different on curriculums according to their own educational objectives.

The undergraduate programs promote well-balanced fundamental education by systematically providing important courses linked between the two programs, since the education limited to its own program is insufficient so as to promote researches in earth and planetary science. Graduate students are expected to take part in one of five major groups according to their own research interests, while actively communicating with other students of different educational backgrounds.

2. Objectives of Self-Assessment and External Review

The board meeting of the University of Tokyo held on March 28, 2011 decided to conduct self-assessment and external review to 'promote self-improvement' and 'achieve accountability.' Accordingly, the university is required to independently and autonomously promote and improve standards of activities such as academic research, cooperation with society and internationalization by comprehending current conditions and future tasks of such activities. It is further required to clarify the role of the University of Tokyo as an international center of education by disclosing the results of the self- assessment and external review, and at the same time, to widely accommodate to social demands by accepting the evaluations and criticisms. Meanwhile, the Graduate School of Science decided, at the faculty meeting held on June 16, 2010, to hold external review for each department and its affiliated institutions within two or three years. As a result of the approval at the Graduate School of Science Review Committee and the Planning Office Conference, it was decided that the external review for the Department of Earth and Planetary Science should be held during this fiscal year. Through this external review, we will self-assess the current conditions and future tasks of the department and disclose the results. At the same time, we will ask for advice on our future education and research plans.

As is more fully described below, external reviews were held in March 1999, a year before the department's establishment through the merger of four previous departments, and also in March 2006, two years after the incorporation of the university. The review committee in 1999 suggested that the undergraduate and graduate education system should be improved, the research activities should be more developed, term appointment of research associates should be introduced, employment of foreign and female faculty members and high technical support should be enhanced and relationship between affiliated institutions should be strengthened. In the meanwhile, the new department's plan was highly evaluated and was advised that the department should have periodic review. At the review held in 2006, six years after the new department's establishment, some of the aspects pointed out in 1999 were confirmed to have been improved and the department received high evaluation in the most part. However, the review committee suggested that the cutting-edge research which would elevate international status should be strengthened, certain selection of research fields

should be done, the head of the department should play a leadership role, screening standards for admission to the doctorate program and qualification for submission of doctoral dissertations should be improved and graduate students should be strongly supported.

Six years have passed since the last external review in March 2006, and the interval synchronizes with a six-year-period of the medium-term plan of the university, thus making an appropriate timing for holding a review this fiscal year.

II. History and Organization

1. History and Operation Policy

(1) History

The Department of Earth and Planetary Science was established in April 2000 through the merger of four previously independent departments (Earth and Planetary Physics, Geography, Geology, and Mineralogy) in the Graduate School of Science. The department had two undergraduate programs - Earth and Planetary Physics Program and Geological Sciences Program, and the latter was reorganized into Earth and Planetary Environmental Science Programs in 2006.

History of the Department of Earth and Planetary Science in the University of Tokyo goes back to 1876 when the university was founded and Department of Geology was established as one of eight departments constituting Faculty of Science. Department of Mineralogy was separated from Department of Geology in 1907, and Department of Geography was newly established in 1919. Followed by the National School Establishment Law promulgated in 1949 after the Second World War, Department of Earth Science consisting of three courses - Geology, Mineralogy and Geography – was established as one of five departments constituting Faculty of Science of the University of Tokyo under the new system.

The predecessor of Department of Earth and Planetary Physics was Department of Seismology, which had originally been established in 1893 as Seismology course within Department of Physics and became an independent department in December 1923 after the Great Kanto Earthquake. Department of Geophysical was established in 1941 by the merger of Department of Seismology and Meteorology course in Department of Physics. Department of Physics was reorganized as a department consisting of three divisions - Physics, Astronomy and Geophysics - in 1949. Geophysical Observatory was established in 1958, and Geophysical Research Institute, in 1964. As a result of the reorganization through expansion of Department of Physics in 1967, three divisions, which had previously constituted the department, became independent as Departments of Physics, Astronomy and Geophysics. Department of Earth and Planetary Physics and Center for Climate System Research were established through the reorganization of Geophysical Institute and Geophysical Research Institute in 1991.

In 1992 and 1993, according to the university's new policy of focusing on graduate education, four departments (Earth and Planetary Physics, Geography, Geology and Mineralogy) were reorganized as main bodies of research and education. The Department of Earth and Planetary Science was established through the merger and full restructuring of the above 4 departments in April 2000. In order to keep playing a leadership role in education and research in Japan, to develop as an international center of research, and to solve urgent problems, the new department was re-grouped by research targets and objectives while the previous departments had been grouped by research methods. As a result, Atmospheric and Oceanic Science group, Space and Planetary Science group, Solid Earth Science group, Geosphere and Biosphere Science group, and lastly, Earth and Planetary System Science group, which aims to integrate all the other groups and to capture the earth and planets as a single system, were founded. On the other hand, two undergraduate programs, Earth and Planetary Physics Program and Geological Sciences Program, which have different educational systems, were maintained based on the understanding that consistent study of basic research skills of either traditional earth and planetary physics or geology should form the foundation of cutting-edge research. Under the university's unique undergraduate course structure, where students choose their major when they proceed from Junior Division (the first two years to study liberal arts) to Senior Division (the third and fourth years), these two programs kept accepting

junior students and providing education in their own way.

In March 2006, six years after the establishment of the new department and with the 21st Century Center of Excellence (COE) program half way through, external review was held since it was considered to be an appropriate timing to receive evaluations and suggestions to the department's present and future research activities, education, and organization. In April 2006, Geological Sciences Program was reorganized into Earth and Planetary Environmental Science Program in response to the emergence of new and attractive research fields such as 'co-evolution of life and environment of the earth' and 'planetary environment.' Based on the recognition that the earth and planetary environment is formed as a result of the complicated interactions among the solid earth and planets, their atmosphere and ocean, and life in the surface environment, the program set its educational objective to empirically understand such interactions through the history of the earth and planets and to observe their behaviors from a view point of system science. Its curriculum was drastically renewed accordingly.

Since the last external review in 2006, a couple of important educational programs have been launched. For example, the Global Center for Excellence (GCOE) program collaborated with Tokyo Institute of Technology was launched in FY 2009. The Overseas Internship Program for Outstanding Young Earth and Planetary Researchers (OIYR Program) was also launched in FY 2009, which offers internship programs to graduate students and young researchers including lecturers, research associates, postdoctoral fellows, and let researchers stay at the world's leading research institutions for a month or two. Leading Graduate Course for Frontiers of Mathematical Sciences and Physics (FMSP) has been launched this fiscal year to support outstanding graduate students throughout their master's and doctorate programs. By supporting students' daily research activities, participation in overseas conferences and international internships through these programs, and by providing own curriculum in the programs, the department promotes research activities in the graduate program and fosters scientists who would be successful in the new era.

(2) Policy of Organizational Operation

Operation of the department has its basis on the five groups. Each group consists of about ten faculty members, making an adequate size for communication. Each group takes care of its own matters concerning graduate students' everyday school life such as education, seat configuration, academic affairs and accounting. The number of faculty members of a group is fixed for each group, and an appointment of a new member is initiated by each group. However, the department takes control of every organizational operation, by holding the department's steering committee, educational committee, accounting committee, rooms committee, public relations committee, network committee, entrance exam committee, library committee, scientific instruments committee and safety management committee. Because academic affairs should be discussed not only within the department itself but also with affiliated groups, the department's educational conference is organized as well. The conference consists of professors, associate professors, lecturers of core groups and affiliated institutions, and the head of the department and the chairman of educational committee co-chair the conference. Undergraduate programs take key roles only in academic affairs such as preparation and implementation of the curriculums and advertisement of the programs. Both undergraduate programs assign the head of the program and educational committee.

The head of the department and the head of each program are elected at the department's faculty committee consisting of every faculty member of the core groups. The committee is also held when there are important matters to be discussed and decided. The tenure of the head of the department had been one year, but considering needs for continuity and long-term scope of the

department operation, the term was changed to two years since FY 2012. The chairman of educational committee and the chairman of accounting committee also have two-year tenure. Operational continuity is maintained since their service periods do not coincide with that of the head of the department. The head of the department chairs the department's steering committee. Each of the other committees consists of the chairman who is appointed by the head of the department and one or two members per core group.

Policies and decisions regarding the organizational operation of the core groups are made at the steering committee. It consists of the head of the department, heads of the two undergraduate programs, and the chairman of each committee. All the committees are open to all faculty members of the core groups. The department's steering committee is held once a month and discusses the matters related to the whole department other than personnel affairs and academic affairs, and each committee chairman also gives a report. The minutes are then circulated among all the faculty members and staffs so that everyone has a view on the current circumstances of the department.

Since the educational committee deals with academic affairs arising from the whole department including the affiliated groups, it consists of the chairman, the chairmen of the educational committee of the undergraduate programs, one educational committee member per core group, and one or two members from each affiliated institution. Academic affairs of the graduate programs are discussed and drafted beforehand at the department's educational committee and are finally decided at the department's educational conference. The educational committees and the educational conferences are held about ten times a year and five times a year, respectively, where all kinds of academic affairs such as enrollment in and graduation from the master's and doctorate programs, entrance exam system and the curriculum of the graduate programs are discussed and decided.

(3) Appointment of Faculty Members

Each core group at the department has four to six research subgroups. Every faculty members including research associates are independent in terms of their own research activities. However, formation of a research subgroup, which would lead to positive research and educational results is regarded as an important criterion when appointing a new faculty member, since it is essential to form subgroups consisting of two to three members, either professor and research associate or associate professor and research associate, to promote education and research.

Responding to the ongoing downsizing policy of personnel made by the university and the Graduate School of Science, the capacity of the department's faculty members are strictly controlled by the total number of faculty members and the proportions of professor ranks, and the downsizing plan through FY 2016 has already been fixed. The total number of faculty members was 58 at the start of the department, but has been decreased to 51. The numbers of professors, associate professors and research associate are decided in a planned manner accordingly. When there is a position available, corresponding group proposes to the faculty committee consisting of all professors to start selection process, and the committee sets up a preparatory working group comprised of the members of the corresponding group and selected professors from other core groups. The working group discusses about the research field for the available position, its role within a framework of the whole department, prospect of potential candidates, and so forth. The result is reviewed at the committee and an outline of the advertisement for the position is decided. All the appointments are done through open announcements including mailing to the other universities and research institutions and informing via email lists and web sites. For each recruitment, a selection committee, consisting of members (whose posts should be equivalent or superior to the applicant) of the corresponding group and one each from other groups, is made and

carefully processes the application. The tentative decision by the selection committee is further discussed by the faculty committee of professors where final decision is made.

Although the number of applicants varies depending on the research field and position, the average numbers are 5 to 10 for professors, 20 to 30 for associate professors and almost 50 for assistant professors, suggesting severe competition for all the appointments.

2. Organization

(1) Core Groups, Affiliated Groups and Affiliated Research /Educational Institutions

The five core groups of the department - Atmospheric and Oceanic Science group, Space and Planetary Science group, Earth and Planetary System Science group, Solid Earth Science group and Geosphere and Biosphere Science group (see the table below) - are closely associated with one another, and the department is in the center of research and education in earth and planetary science in Japan. Furthermore, the department has five affiliated groups - Observational Solid Earth Science Group of the Earthquake Research Institute, Climate System Science Group and Advanced Oceanic Science Group of the Atmosphere and Ocean Research Institute, Super-High-Pressure Solid Physics Group of the Institute for Solid State Physics and Earth Atmospheric Environment Science Group of the Research Center for Advanced Science and Technology - and one cooperating group, Inter-Institutional Science Group of the Japan Aerospace Exploration Agency (JAXA). In addition, the department is closely associated with institutions in the university such as Geochemical Research Center, Department of Physics, Graduate School of Frontier Sciences, Graduate School of Arts and Sciences, Center for Spatial Information Science, the University Museum and the Interfaculty Initiative in Information Studies, and with outside institutions such as Japan Agency for Marine-Earth Science and Technology. With the above groups and institutions, the department has been promoting education and research in earth and planetary science.

Geochemical Research Center in the Graduate School of Science, while working closely with the Department of Chemistry, puts emphasis on the field of geochemistry, which is not much covered in the research areas of the department's core groups, especially on material chemistry of the earth's interior and cosmochemistry, and plays a key role in both research and education in the department.

This external review covers the core groups only. Data for the enrollment and theses/dissertations of the Master's and Doctorate Program are, however, presented for the entire department with distinction of core and affiliated/cooperating (affiliated hereafter) groups.

The Department of the Earth and Planetary Science

Core Groups	Atmospheric and Oceanic Science Group	Affiliated Groups	Observational Solid Earth Science Group	Earthquake Research Institute
	Space and Planetary Science Group		Climate System Science Group	Atmosphere and Ocean Research Institute
	Earth and Planetary System Science Group		Advanced Oceanic Science Group	
	Solid Earth Science Group		Super-High-Pressure Solid Physics Group	Institute for Solid State Physics
	Geosphere and Biosphere Science Group		Earth Atmospheric Environment Science Group	Research Center for Advanced Science and Technology
		Cooperating Group	Inter-Institutional Science Group	Japan Aerospace Exploration Agency (JAXA)

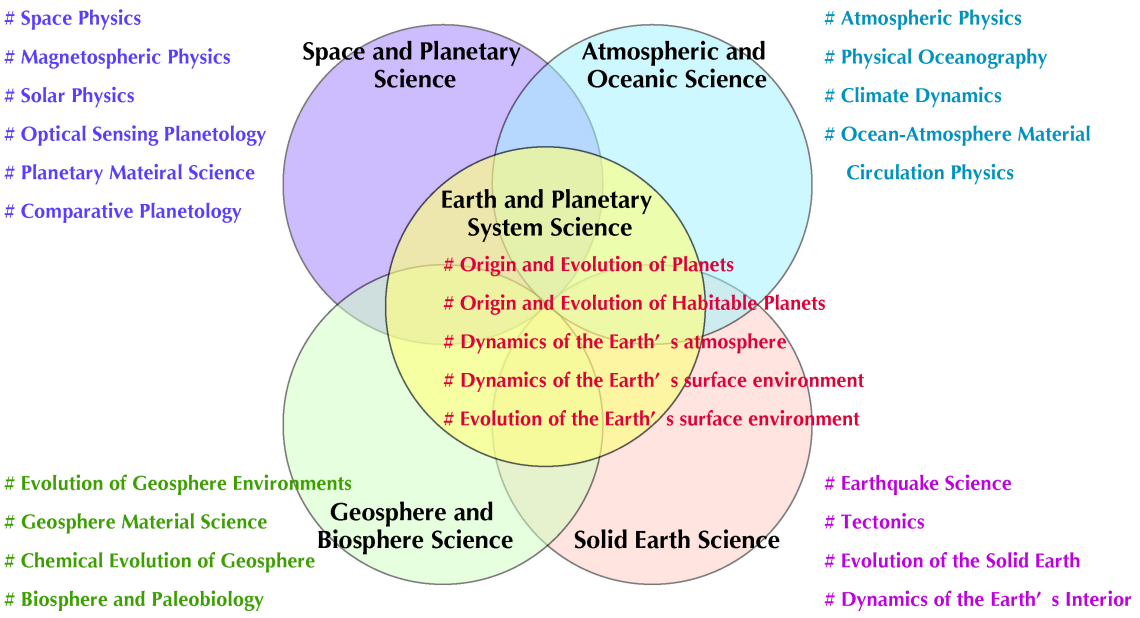
Cooperating Departments, Graduate Schools and Research Institutes

Geochemical Research Center	Center for Spatial Information Science
Department of Physics	The University Museum
Graduate School of Frontier Sciences	The Interfaculty Initiative in Information Studies
Graduate School of Arts and Sciences	Japan Agency for Marine-Earth Science and Technology

(2) Fields and Their Objectives

In order to comprehend the complicated phenomena that occur in the earth and planets in a wide range of time and spatial scales and that interact intimately among different scales, it is indispensable to promote deeper understandings of each phenomenon, and at the same time, to

Science Fields: Department of Earth and Planetary Science



integrate the phenomena into the seamless earth and planetary system. Based on such concept, the department is divided into five groups - Solid Earth Science group, which studies 'solid earth', Atmospheric and Oceanic Science group, which studies 'fluid earth' on the earth's surface, Space and Planetary Science group, which studies the solar system and planetary space, Geosphere and Biosphere Science group, which studies biosphere, and Earth and Planetary System Science group which integrates studies conducted in all the other groups. Each group has its own education and research objectives, and pursues such activities by collaborating closely among the groups through their boundary regions.

<Atmospheric and Oceanic Science Group>

Our planet Earth is covered by the atmosphere containing water vapor and the ocean occupies more than 70% of the global surface. It is one of the most unique characteristics of the earth that water exits in all three phases of vapor, liquid and solid. Water vapor in the atmosphere absorbs solar and terrestrial radiations quite effectively, and liquid water in the ocean has a large specific heat and is extremely solvent and fluid. Phase changes of the water associate with large latent heat. All those characteristics of the water introduce rich daily weather, seasonal changes and climate variations into our planet. Building a society less vulnerable to water-related natural disasters has been a major motive for our civilization. Moreover, the ozone layer which is maintained by global circulation in the atmosphere and protecting the earth biosphere from harmful solar UV radiation has been largely affected by human activities.

This group will be devoted to high-level education as well as research on those oceanic and atmospheric phenomena of various space and time scales from breaking internal waves to centennial global climate changes. The efforts will contribute to enhancing our basic knowledge on predictability of oceanic and atmospheric phenomena of great societal concern. To be more specific, this group, through data analysis, analytical methods, global modeling and field observations when necessary, encourages development of our understanding of oceanic and atmospheric flows and turbulence, ocean-atmosphere coupled phenomena generating climate variations, circulation of various oceanic and atmospheric substances such as ozone, carbon and fresh water.

In order to fulfill above purposes, we introduce the following four research subgroups and proceed to realization of world leading research and education in the realm of oceanic and atmospheric science.

• Atmospheric Physics:

In the Earth's atmosphere, interactions among physical processes including dynamical, radiative and cloud physics, and with the ocean produce various phenomena in a wide range of spatial and temporal scales. This group will devote their efforts to research and education with a special emphasis on the atmospheric dynamics by theoretical, observational, numerical modeling and data analysis approaches. Our definite objectives are to understand the dynamics of global circulations, waves, instabilities and turbulence in the troposphere through the lower thermosphere, and to understand the mechanisms of the cloud organization. Outcomes from this group will be particularly beneficial to the general society through assessment of the climate system as well as improvement of prediction models.

• Physical Oceanography:

This research group will devote their major efforts to understanding and education of various physical processes such as eddy-eddy interaction, eddy-mean flow interaction and turbulent mixed-layer dynamics in the ocean. Those processes that are crucial to accurate modeling of the large-scale ocean general circulation are clarified through analytical and numerical studies as well as

analyses of in situ and remote sensing data. Areas of current particular interest are interaction between mesoscale eddies and global ocean currents, parameterization of diapycnal mixing processes caused by breaking internal waves, and advanced modeling of the ocean surface mixed layer to be embedded in next-generation general circulation models.

• Climate Dynamics:

This research group is devoted to understanding of interannual climate variations such as El Niño and the Indian Ocean Dipole, climate variations in decadal-to-centennial timescales, and interactions between low-latitudes and mid-high latitudes phenomena based on theoretical studies, observational data analyses, and general circulation model simulations. In particular, the group is intended to contribute to the society by advancing the predictability study of large-scale climate variation phenomena.

• Ocean-Atmosphere Material Circulation Physics:

This research group focuses on studying atmospheric aerosols and gaseous compounds that affect climate and air quality. Variations of these atmospheric constituents as well as their impacts on radiation and cloud physics are studied. This group wishes to create a new atmospheric science field by integrating atmospheric chemistry and physics. This group also studies oceanic thermohaline processes, water-mass formation and circulation of oceanic substances such as fresh water, salt, nutrients and carbon.

<Space and Planetary Science Group>

We, the space and planetary science group, conduct research and education to comprehensively understand both the unique and the common characteristics of elementary physical processes, structures, compositions, and dynamics in various regions of planets, planetospheres, the heliosphere, and space, and also the interactions among those regions. To accomplish these objectives, we have systematically combined theoretical means including numerical simulation, observational means including in-situ observations by artificial satellites and planets, planetary orbiters, sounding rockets, balloons, ground equipment, as well as simulation experiments and measurements in ground laboratories.

• Space Physics and Magnetospheric Physics:

The two subgroups of space physics and magnetospheric physics among those in the Space and Planetary Group have the closest and shared research interests in various plasma processes and phenomena that occur in the Earth's magnetosphere, Heliosphere, and the plasma universe. It is known that plasma pervades the universe at many scales. The Sun-Earth system spans the distance of 10^{-4} light years. The plasma ejected from the solar atmosphere expands as the solar wind toward the Earth, and the Earth's magnetic field that is surrounded by the solar wind forms the magnetosphere. Jumping ten orders of magnitude in size, extra-galactic jet systems are among the largest plasma structures in the universe. The jets are emanating from the central massive black hole surrounded by a rotating accretion disk. Dynamics of the astrophysical jets and the accretion disk are similarly regulated by common plasma physics that appears in the Sun-Earth system. Thus, the study of space and planetary plasma physics in the University of Tokyo encompasses not only the domain of space physics (the Sun, the Heliosphere, and the magnetospheres of the Earth and the planets) but also the usual realm of astrophysics beyond the solar system.

• Solar Physics:

The research in the solar physics is also carried out not only in the framework of the space physics but also with a scope under the astrophysics and the plasma physics. Both observational studies and theoretical studies by using the high-performance computing facilities with simulation

codes based on our original algorithm would enhance our understanding of various phenomena on the Sun.

• **Optical Sensing Planetology:**

The target of the Optical Sensing Planetology subgroup is various optical phenomena occurring in planetary atmospheres. The final goal is to draw scenarios for their origin and evolution by quantifying parameters controlling the present physical and chemical processes.

• **Planetary Material Science:**

In the field of planetary material science, we use various techniques for understanding extra-terrestrial materials. In particular we have advanced techniques of mass spectrometry, crystallography, X-ray spectrometry, etc. These techniques are used for understanding evolutions of the early solar system and solid bodies such as Mars, the Moon and asteroids.

• **Comparative Planetology:**

In the field of comparative planetology, theoretical, data-based and mission-oriented studies should be advanced hand in hand. Geophysical data such as gravity and magnetic fields are important. Surface mineralogy, chemistry and topology are also indispensable.

<Earth and Planetary System Science Group>

Planets consist of subsystems such as magnetosphere, atmosphere, hydrosphere, biosphere, mantle, and core, and the subsystems interact with various degree of feedback. The interaction among subsystems takes place with different time constants, which results in non-linear complex responses for the entire system. Earth and Planetary System Science (EPSS) group aims to construct a new science field of "Earth and planetary system science" to understand the structure and evolution of the earth and planets as huge complicated systems, which is different from "Earth system science" often used for the Earth's surface environmental system. We are trying to see nature and the results of theoretical calculations with multifaceted views and trying to strengthen our theoretical background of physics and chemistry. In order for graduate students to learn this concept, we are organizing three types of seminars; one is "System seminar" for the whole Earth and planetary science group member, the second type includes two seminars, one for planetary science and one for surface environmental sciences, and the third type is for individual small group. Members of the EPSS group join those seminars that are held regularly.

Currently, we are carrying out following scientific topics.

• **Origin and Evolution of Planets:**

Finding of exoplanets has changed earth science from sole science to universal science. We are working on formation and evolution of dusts and protoplanetary discs, formation of planets, formation of atmosphere and ocean on the planet surface, differentiation of planetary interior, which are the fundamental process of subsystem formation.

• **Origin and Evolution of Habitable Planets:**

Planetary habitability is governed by several factors that include planetary orbit, atmospheric pressure and composition, presence and depths of oceans, stability of surface environments, presence or absence of plate tectonics, distribution of continents, and so on. We are investigating diversity of surface environments on terrestrial planets and their sensitivities to the above factors, and explore the possibility of the existence of habitable planets beyond the solar system.

• **Dynamics of the Earth's Atmosphere:**

Scattering and absorption of solar radiation by aerosol particles contribute significantly to the earth's radiation budget through the cooling and heating of the atmosphere. Cloud albedo is influenced also by the number density of aerosol particles, on which water vapor condenses to form

cloud droplets. Therefore, studies of the physical and chemical properties of aerosols and clouds and their behaviors constitute the basis of the understanding of the changes of the earth's environment and climate. We aim for quantitative understanding of the radiation budget by studying the key processes of aerosols and clouds by field and laboratory experiments, in combination with advanced numerical models.

• **Dynamics of the Earth's Surface Environment:**

Biosphere forms one of the key components of earth surface system. It receives human impacts and interacts with global and local environmental changes. We evaluate the role of the biosphere in the global earth surface changes through field survey and laboratory experiment as well as modeling.

• **Evolution of the Earth's Surface Environment:**

Stable mode of global environment changes through the earth history due to the changes in internal and external forcings. The global environment occasionally has multiple stable modes and transitions among such modes are associated with abrupt mode jumps. The mode jumps occurred in various time scales and either repeated with hysteresis or changed irreversibly. The earth and planetary system science group conducts reconstruction of modes of past environmental changes through field survey and laboratory works and explore mechanisms of such changes from the viewpoints described above.

<Solid Earth Science Group>

The solid earth science group studies the physical and chemical state of the crust, mantle, and core on a variety of temporal and spatial scales. We seek a quantitative and comprehensive view of the Earth's present state and the processes by which it evolved, and of the interactions between layers. Among the phenomena we study are earthquakes and volcanoes, crustal deformation and the evolution of surface topography, the thermal state and material transport in the mantle, the formation, evolution, and subduction of the oceanic crust, core dynamics and the generation of the Earth's magnetic field. To understand this complex system we use a wide variety of approaches, including continuum mechanics, geodynamics, theories of fracture and failure, studies of topography, structural geology, petrology, crystallography, geochemistry, theoretical and experimental high pressure-high temperature mineral physics, magneto-hydrodynamics, seismic tomography and waveform inversion, earthquake source theory, large scale numerical simulation, analyses of large datasets on a global scale, and field studies. We are studying the solid earth using the above wide variety of approaches and viewpoints with the goal of achieving a unified and comprehensive understanding of its evolution. Our group has chosen to focus on the following four areas: Earthquake Science (phenomena on time scales from seconds to hundreds of years associated with earthquake occurrence), Tectonics (in particular, phenomena on times scales from hundreds of years to millions of years occurring at convergent margins), Evolution of the solid Earth (chemical and physical phenomena on times scales from millions of years to billions of years involved in the formation and evolution of the Earth as a whole), and Dynamics of the Earth's interior (the state and structure of the Earth at present). We discuss our efforts in each of these four areas in detail below.

• **Earthquake Science:**

We conduct research on the quasi-static buildup of elastic energy and stress, pre-seismic acceleration of slip on faults, the occurrence of large earthquakes and radiation of seismic waves, after-slip, recovery processes in the fault zone, and stress redistribution due to relaxation in the asthenosphere. By understanding these processes on a variety of spatial and temporal scales we will improve our understanding of the earthquake occurrence process as a complex system and obtain reliable statistical models. On the basis of the above research we will evaluate the predictability of

earthquakes.

• **Tectonics:**

We seek unified and quantitative understanding of subduction-related orogeny, continental collision, and back-arc spreading, considering the interaction between endogenetic processes caused by physical and chemical reactions within plate boundary zones, and exogenetic processes (such as erosion, transportation and deposition) that are controlled mainly by climate.

• **Evolution of the Solid Earth:**

We seek an understanding of the differentiation of materials and the formation of the structure of the Earth's interior, particularly of the crust and core, and of the energetics and mechanisms of material transport processes, and of the interactions between the surface and the crust, the crust and the mantle, and the mantle and core. Through our study of the above phenomena we will contribute to achieving a unified and quantified model of the thermal and chemical evolution of the Earth from its formation to the present.

• **Dynamics of the Earth's Interior:**

By analyzing data on a global scale, conducting large scale numerical simulation, and carrying out leading-edge laboratory experiments we seek an understanding of the present state and evolution of the crust, upper mantle, transition zone, lower mantle, and outer and inner core. We particularly focus on the interactions between the various layers and on elucidating the heterogeneous properties of each layer, from thermodynamic, geodynamic, electromagnetic, and material science viewpoints, with the aim of synthesizing these analyses to obtain a unified understanding of geodynamics.

<Geosphere and Biosphere Science Group>

Members of this group study and teach various aspects of formation of geosphere materials, evolution of the geosphere, the origins and evolution of life, and fundamental processes of geosphere-biosphere interactions. These studies are based mainly on field observations, analyses of geological, mineralogical, and paleontological samples, and laboratory experiments using various techniques such as transmission electron microscopy, scanning electron microscopy, atomic force microscopy, X-ray microanalyses, X-ray diffraction analysis, gas- and ICP-mass spectrometry, gas-chromatography, and amino-acid and DNA sequence analyses. The methodologies and objectives of the studies in this group are, therefore, partly common with those in other groups, especially the Earth and Planetary System Science and the Solid Earth Science, but we have stronger intention to explore the interdisciplinary field between earth and biological sciences than in other groups. Our research field is also related to human activities, since it focuses on the co-evolution between geosphere environments and life.

We study and teach in four subgroups as described below. These subgroups collaborate to achieve the above-mentioned objectives of this group.

• Evolution of Geosphere Environments:

This subgroup aims to reconstruct environmental evolution of the geosphere (combination of the lithosphere, hydrosphere, and atmosphere) based on both field observations and laboratory experiments, from the viewpoints of sedimentology and historical geology. This subgroup's work has the overall aim of clarifying the interrelations among the geosphere and biosphere throughout the 4.6 billion years of the Earth's history. Important projects in this subgroup include elucidation of short-term and long-term evolution of the geosphere, with special reference to biomarker and stable isotope signals recovered from sedimentary rocks and various geological samples.

• Geosphere Material Science:

This subgroup focuses on the structure of materials (mainly minerals) at the Earth's surface,

their formation mechanisms, and the fundamental processes of interaction between geosphere materials and aqueous solutions. This research will be investigated on the atomic scale by X-ray diffraction analysis, electron microscopy, and related techniques. Currently important subjects are 1) crystal-chemical properties of geosphere materials, 2) atomic-resolution transmission electron microscopic studies of minerals and their fine structures, 3) fundamental dissolution and weathering reactions of silicate minerals and their effects on elemental transport, 4) weathering in the Precambrian and the evolution of the atmosphere, and 5) organic-inorganic interactions and interface structures between biomolecules and crystals in the process of biomineralization.

• Chemical Evolution of Geosphere:

This subgroup will study the origin and evolution of the chemical conditions of the geosphere and biosphere in relation to the evolution of life, through the analysis of chemical variations in constituents of the geosphere and biosphere, processes and mechanisms of transportation, concentration, and dispersion of materials, and microbial activity and organic production of geosphere and biosphere materials. Currently important subjects are 1) chemical and biological linkages in various extant environments such as hydrothermal, crustal, cold-seep, and sedimentary ecosystems, 2) cycling, toxicity and bioavailability of trace elements, 3) proxy development for paleo-redox conditions.

• Biogeology and Paleobiology:

Study in this subgroup concerns biological aspects of extinct or ancient life forms based on comparative analysis of fossils and extant organisms. Major goals are to better elucidate the tempo, mode and mechanism of morphological evolution of life throughout the Earth's history, and the role of life in the formation and evolution of the geosphere. Currently important subjects are 1) early evolution and phylogeny of marine invertebrates based on embryological, molecular biological, and paleontological data, 2) mechanisms and evolution of biomineralization especially of molluscan shells, 3) comparative anatomy of amniotes, with special emphasis on dinosaur evolution, 4) paleobiology of dinosaurs involving cutting-edge technologies, such as X-ray CT-scan, 5) molecular paleontology and paleogenomics based on both molecular fossils and the information stored in the genomes of extant organisms.

(3) Faculty Members of Core Groups

As of January 1, 2013, the capacity of faculty of the core groups is as follows: 21 for professors, 19 for associate professors and 11 for assistant professors, bringing the total to 51. In addition, there is a position for female fixed-term assistant professor at the Graduate School of Science. On the other hand, the numbers of the faculty members in office are 15 for professors, 15 for associate professors, 3 for lecturers and 11 for assistant professors, bringing the total to 44, and 9 members are now being selected. The numbers by the groups are 6 for Atmospheric and Oceanic Science Group, 11 for Space and Planetary Science Group, 8 for Earth and Planetary System Science Group, 11 for Solid Earth Science Group and 8 for Geosphere and Biosphere Science Group. In addition, one GCOE Project Assistant Professor and 5 other Project Assistant Professors are employed by external funds. All the faculty members belonging to the department are listed below.

Faculty Members of Core Groups (As of January 1, 2013)

Name	Rank	Specialty
Atmospheric and Oceanic Science Group		
SATO, Kaoru	P	Atmospheric Dynamics, Middle Atmosphere Sciences

HIBIYA, Toshiyuki	P	Ocean Dynamics, Deep Ocean Mixing, Ocean Wave Theory
KOIKE, Makoto	AP	Atmospheric Environmental Science/Atmospheric Chemistry
TOZUKA, Tomoki	AP	Physical oceanography, Climate dynamics
MIURA, Hiroaki	AP	Atmospheric dynamics, Tropical dynamics, Atmospheric modeling
TANAKA, Yuki	RA	Dynamical Oceanography, Physics in Marginal Seas, Mixing Processes in Straits
NIWA, Yoshihiro	PAP	Physical Oceanography
OETTLI, Pascal	PRA	Climate Dynamics
Space and Planetary Science Group		
SUGIURA, Naoji	P	Planetary Science
HOSHINO, Masahiro	P	Space Physics
MIYAMOTO, Masamichi	P	Planetary Material Science
IWAGAMI, Naomoto	AP	Optical remote sensing of planetary atmospheres
HIYAGON, Hajime	AP	Planetary Science, Isotope Cosmochemistry, Meteoritics
MIKOUCHI, Takashi	AP	Planetary Science, Mineralogy, Meteoritics
YOKOYAMA, Takaaki	APP	Solar and Astrophysical Plasma Physics
YOSHIKAWA, Ichiro	RA	Planetary airglow
AMANO, Takanobu	RA	Space Physics
MIURA, Akira	RA	Space Plasma Physics
YAMAMOTO, Takashi	RA	Solar-Terrestrial Physics
Earth and Planetary System Science Group		
KAYANNE, Hajime	P	Earth System Science (coral reef, coast, carbon cycle, global change, paleoenvironment)
KONDO, Yutaka	P	Global Atmospheric Environment
TADA, Ryuji	P	Earth System Dynamics, Paleooceanography, Paleoclimatology, and Sedimentology
NAGAHARA, Hiroko	P	Planetary Science
ABE, Yutaka	AP	Planetary System Physics (Planetary evolution, Planetary atmosphere, Planetary climate)
IKOMA, Masahiro	AP	Theoretical planetology, Exoplanetology
TAKAHASHI, Satoshi	RA	Palaeontology, Geochemistry
KAWAHARA, Hajime	RA	Exoplanetology
GENDA, Hidenori	PRA	Theoretical Planetary Science
MOTEKI, Nobuhiro	PRA	Atmospheric Material Science, Atmospheric Dynamics
MATSUI, Hitoshi	PRA	Atmospheric Chemistry, Atmospheric Environmental Science
Solid Earth Science Group		
OZAWA, Kazuhito	P	Petrology
KIMURA, Gaku	P	Tectonics and Structural Geology
GELLER, Robert	P	Seismology
IKEDA, Yasutaka	AP	Tectonic geomorphology, Active tectonics
IDE, Satoshi	AP	Earthquake Source Physics

FUNAMORI, Nobumasa	AP	High-pressure mineral physics
IIZUKA, Tsuyoshi	L	Geochemistry and cosmochemistry
TANAKA, Hidemi	L	Material Seismology, Structural Geology
SAKURABA, Ataru	RA	Geodynamics, Planetary dynamos, Geomagnetism
SHIMIZU, Ichiko	RA	Structural Geology, Rock Rheology
NAMIKI, Atsuko	RA	Geodynamics, Physical Volcanology
KAMEDA, Jun	PRA	Mineralogy, Structural Geology
SUZUKI, Takehito	PRA	Earthquake Source Physics
Geosphere and Biosphere Science Group		
URABE, Tetsuro	P	Chemical Geology, Economic Geology, Hydrothermal activity, deep biosphere
ENDO, Kazuyoshi	P	Molecular Palaeontology, Skeletogenesis
MURAKAMI, Takashi	P	Environmental Mineralogy
KOGURE, Toshihiro	AP	Mineralogy, Material Science, Electron Microscopy, crystallography
SUZUKI, Yohey	AP	Geomicrobiology, Geochemistry, Nanomineralogy
TSUIHIJI, Takanobu	L	Vertebrate paleontology, Vertebrate comparative morphology
OGIHARA, Shigenori	RA	Organic Geochemistry
SUNAMURA, Michinari	RA	Geomicrobiology, Microbial Ecology

P: Professor, AP: Associate Professor, L: Lecturer, RA: Research Associate/Assistant Professor, PAP; Project Associate Professor, PRA: Project Research Associate/Project Assistant Professor, EP: Emeritus Professor retired on Mar. 31, 2012

The ages range from 49 to 63 (averaging 58±5) for professors, 36 to 62 (averaging 47±9) for associate professors, 33 to 50 (averaging 40±9) for lecturers and 29 to 63 (averaging 44±12) for assistant professors.

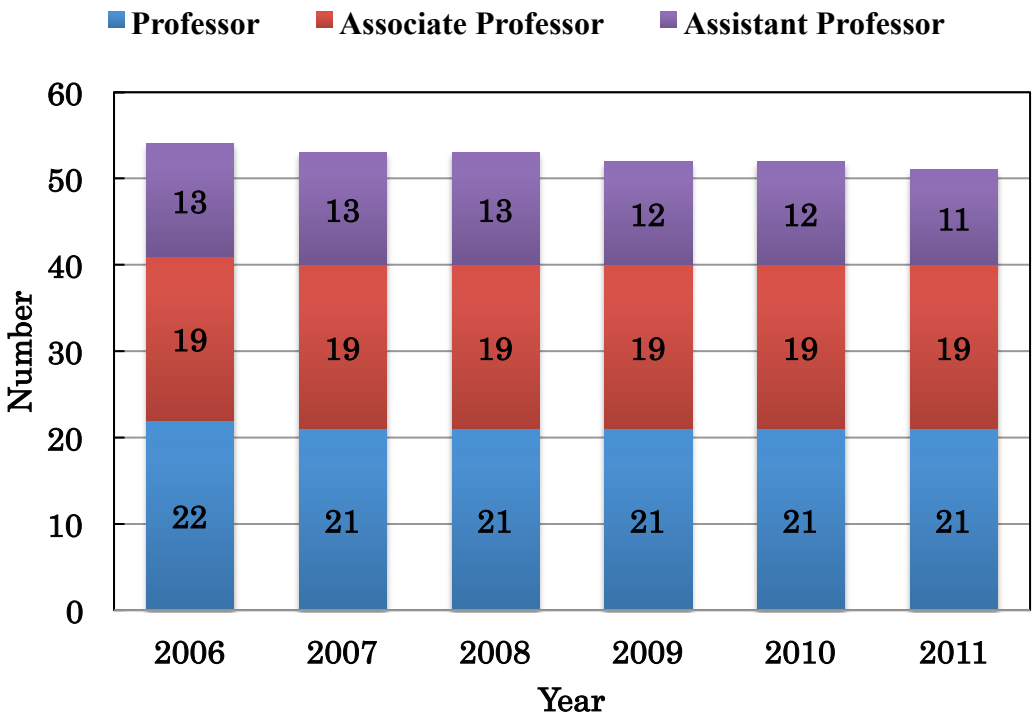
3. Changes in the Number of Faculty Members

Changes in the capacity of faculty controlled by the university are shown in the chart below, which indicates that the number has been reduced from 54 in FY 2006 to 51 in FY 2011. Changes in personnel (the numbers of professors, staffs, researchers, teaching assistants and research assistants as of April 1 in each FY) are also shown below. The numbers of project assistant professors and associate professors have changed significantly owing to the acquirement of external funds such as 21st Century Center of Excellence (COE) program and Grant-in-Aid for Scientific Research on Innovative Areas.

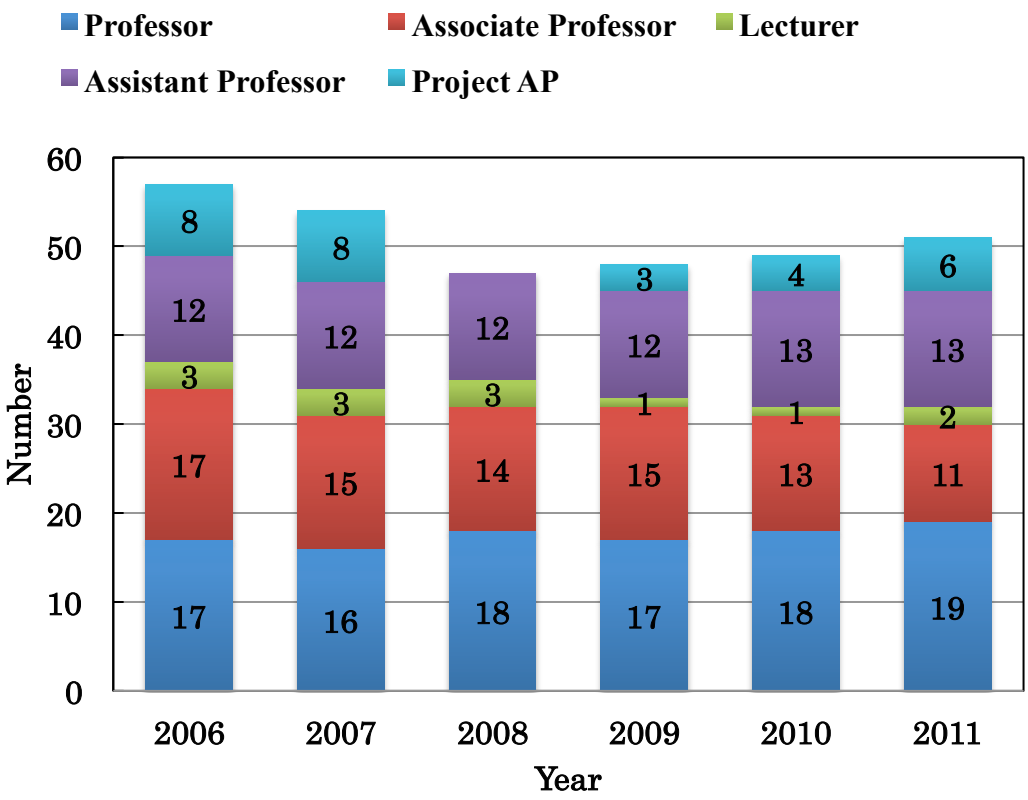
About one third of the faculty of overall department has changed: 10 professors have retired or moved out while 6 have moved in, 9 associate professors (including lecturers) have moved out while 7 have moved in, and 6 assistant professors have moved out while 4 have moved in, totaling to increase of 17 members and decrease of 25 members. This indicates high activity of the department in terms of personnel. However, a few members have stayed as assistant or associate professors over ten years, resulting in the stagnation of the department organization. Although downsizing in the capacity of the faculty has forced to decrease the capacity of assistant professors, the department in recent years has actively employed project assistant professors, who would play an important role not only in research but also in education, giving seminars and instructing graduate students.

(1) Changes in the Number of Faculty Members

<Capacity of Faculty>

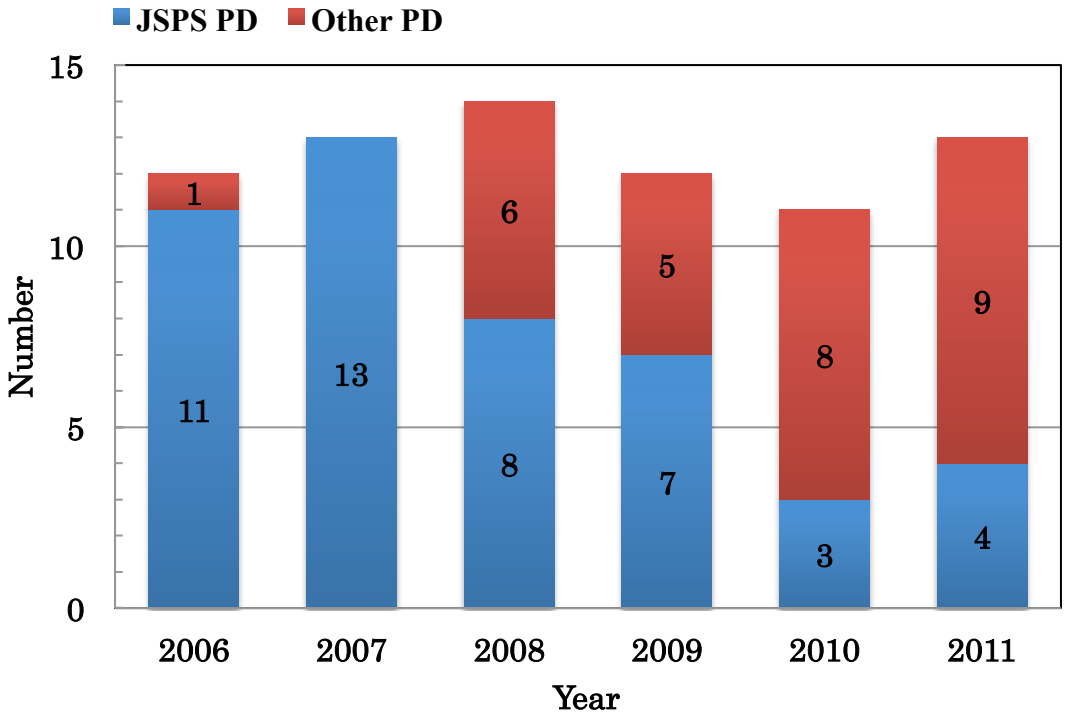


< Number of Faculty Members as of Every April 1>

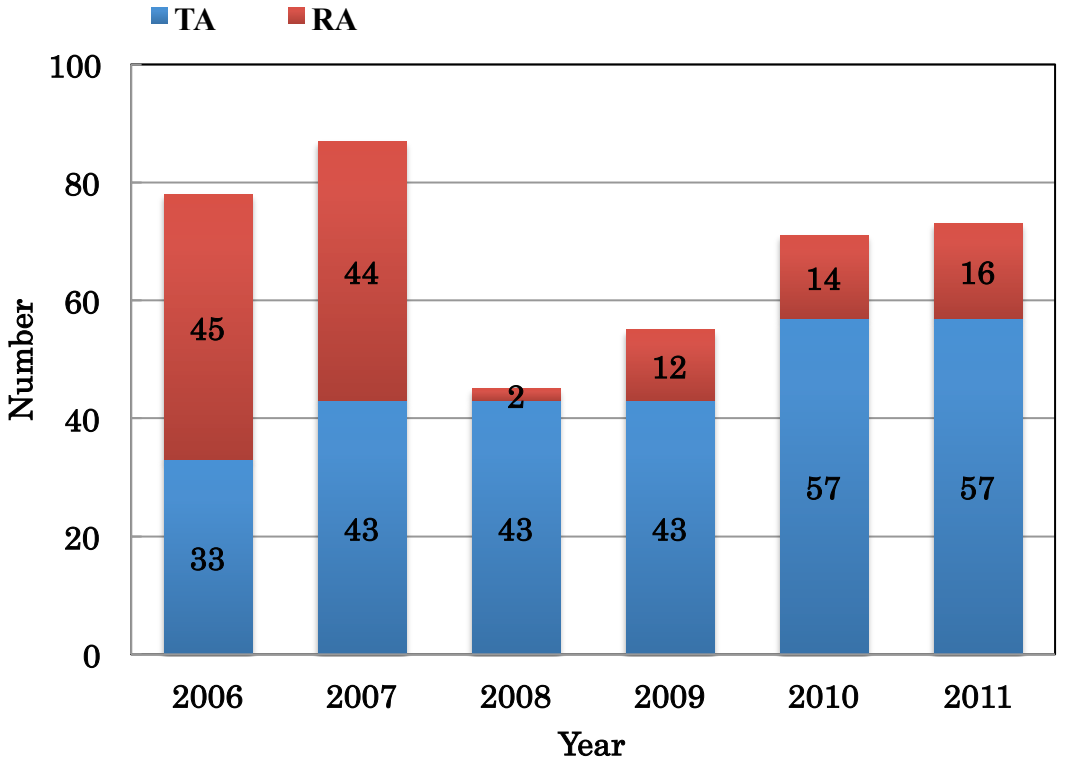


Project AP: Project Associate Professor or Project Assistant Professor

(2) Changes in the Number of Postdoctoral (PD) Researchers



(3) Changes in the Numbers of Teaching Assistants (TAs) and Research Assistants (RAs)

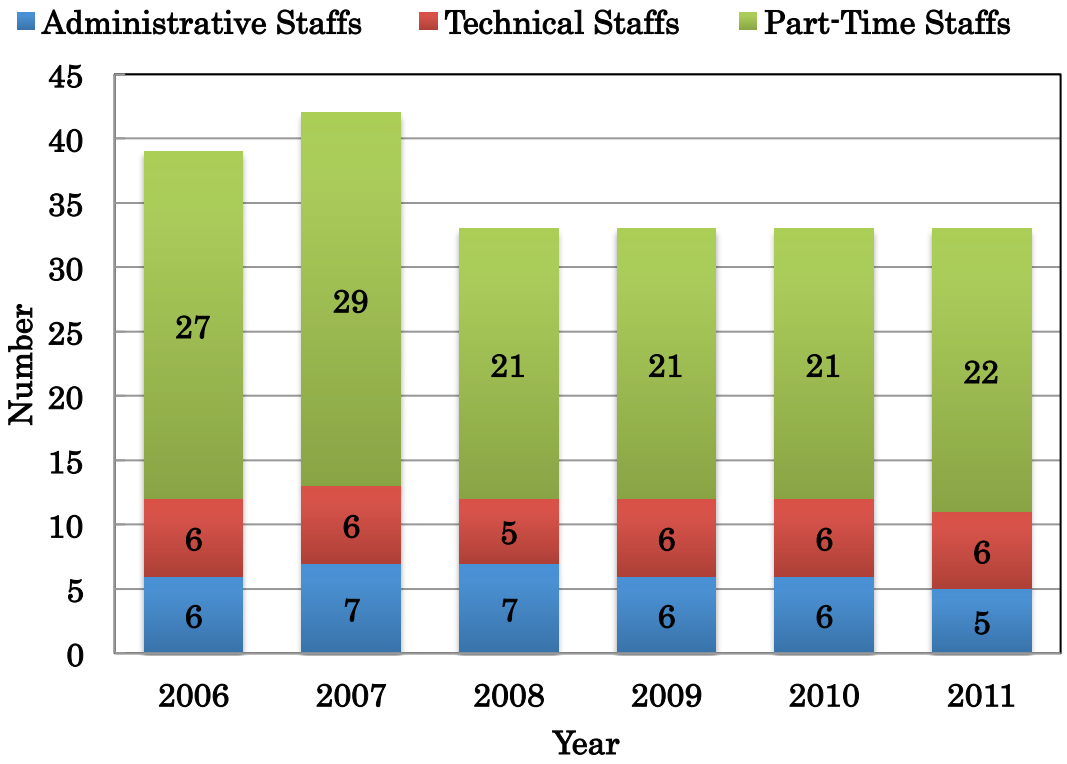


TAs are basically employed for the classes (seminars and laboratory experiments) supported by the university, and most of them are master's students. The number of TAs is controlled by the amounts to be paid. On the other hand, RAs are employed by externally funded programs such as from Ministry of Education, Culture, Sports, Science and Technology (MEXT) and Japan Society

for the Promotion of Science (JSPS). RAs employed in FY 2006 and FY 2007 were mainly for 21st Century Center of Excellence (COE) program and those employed since FY 2009 have been mainly for Global Center for Excellence (GCOE) program. The number of RAs depends on the programs' budgets. As stated below, the enrollment in doctorate program dropped significantly in FY 2008. It is believed to be due to the loss of support by 21st Century Center of Excellence (COE) program, clearly indicating the importance of financial support for graduate students.

(4) Changes in the Number of Staff

The number of staff has been almost flat. The number of part-time staff has been kept at a reasonable level since FY 2008 according to the reorganization of office function.



4 . Information Regarding Facilities

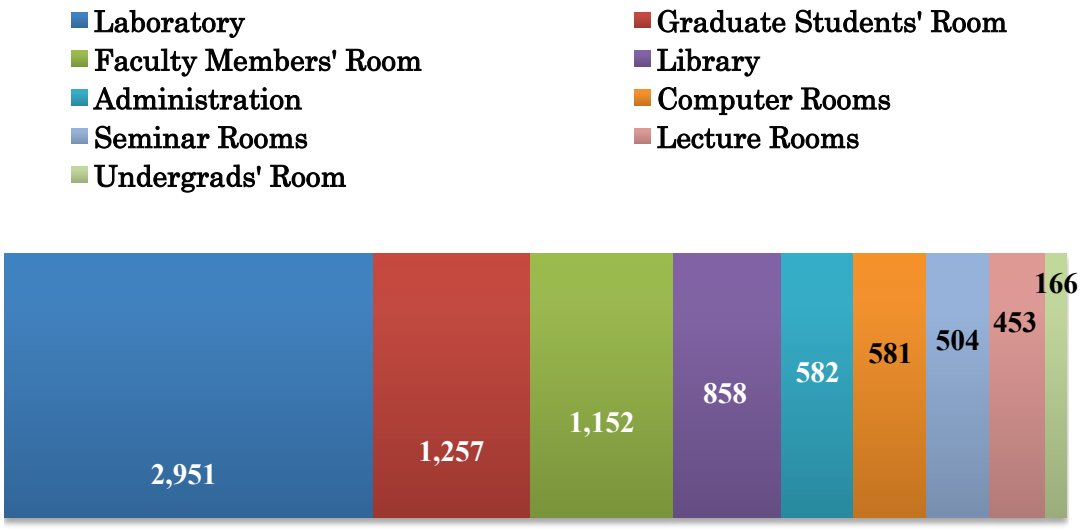
(1) Areas

Main facilities of the department are scattered among Science Building 1 (West wing and Central wing,) 3 and 4. The areas for Science Building 1 (West wing,) Science Building 1 (Central wing,) Science Building 3, and Science Building 4 are 1,743m^2, 4,797m^2, 1,409 m^2 and 366m^2, respectively. Capacity utilization rate is 91.2%, calculated by the standard set by Ministry of Education, Culture, Sports, Science and Technology based on the number of faculty and students. The Graduate School of Science is requesting for a third-stage construction of Science Building 1 (East wing.) If this materializes, the facilities now in Science Building 3 will be moved into Science Building 1, and thus all the facilities will be gathered into a single building, improving the convenience of research and education.

		Bld. #1, West	Bld. #1, Central	Bld. #1, Old	Bld. #3	Bld. #4	Other Facilities	Sum
Lecture rooms	Number	4	2	0	1	0	0	7
	Area	183	144	0	126	0	0	453
Seminar rooms	Number	2	11	0	0	0	0	13
	Area	82	422	0	0	0	0	504
Library	Number	0	1	0	0	0	3	4
	Area	0	680	0	0	0	178	858
Laboratory	Number	1	43	1	17	5	2	69
	Area	23	1,879	40	763	134	71	2,910
Technical support room	Number	0	0	0	1	0	0	1
	Area	0	0	0	41	0	0	41
Faculty members' rooms	Number	17	28	0	4	2	0	51
	Area	361	596	0	161	34	0	1,152
Students' rooms	Number	10	12	0	5	0	0	27
	Area	613	743	0	167	0	0	1,523
Computer rooms	Number	4	4	0	1	2	0	11
	Area	198	207	0	81	95	0	581
Administration	Number	5	4	0	2	2	0	13
	Area	283	126	0	70	103	0	582
Sum	Number	43	105	1	31	11	8	196
	Area	1,743	4,797	40	1,409	366	249	8,604

Area in m^2

< Floor Space >



Aea in m^2

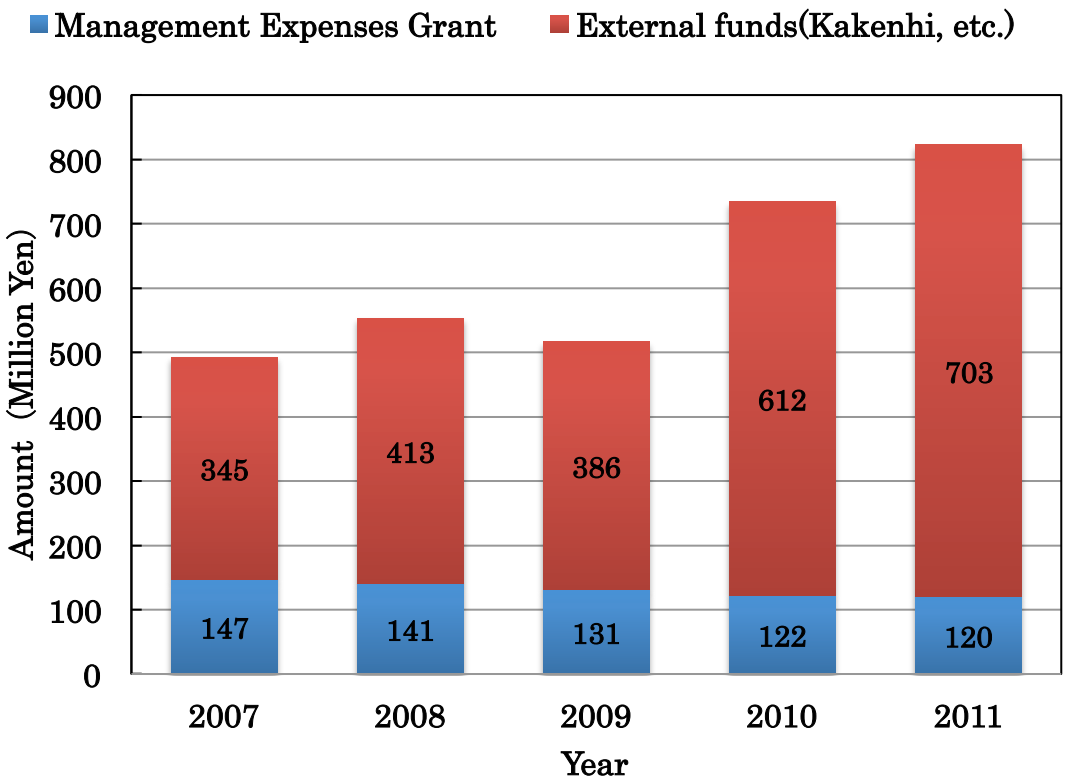
(2) Equipments

The department has various analytical instruments as shared equipments and a cluster server (Photon) purchased by the Advanced Leading Graduate Course for Photon Science (ALPS.) The server is managed by a user group, and the core network and the department's servers are managed and operated by the network committee.

Scientific instruments committee manages analytical instruments, and the ways of management and maintenance are decided depending on each instrument's versatility. Highly versatile eight instruments in the department are now designated as A-ranked, which are repaired by the department's contribution and are disclosed for shared usage in the department. Repair charges for B-ranked instruments have to be refunded by their managers to the department. Maintenance and management of large instruments are thus steadily controlled, and urgent repairs can be done accordingly. Details are described in the shared instruments brochure. Other than these shared equipments, many laboratory equipments and observational equipments are maintained and managed in each lab but are basically not disclosed, since they are for research purpose. Whereas most of the instruments for researches are also used for educational purpose, some are managed as purely educational by the relevant faculty members.

5． Changes in Income (FY 2007 - FY 2011)

(1) Outline of the Department's Budgeted Income



The budget of the department has changed drastically in the past five years. Management expenses grants have been decreasing by a few percent every year and have shrunk to 80% in just five years. In the meanwhile, acquirement of external funds has increased significantly and has more than doubled in five years. The department's increased acquirement of grants-in-aid for scientific

research is noteworthy. However, if the proportion of external funds becomes too large, risks for the department putting great emphasis on education will also increase. Therefore, the department has to prepare measures to maintain education system in the case when the amount of external funds drops.

(2) Income Breakdown of External Funds (Amount in K Yen)

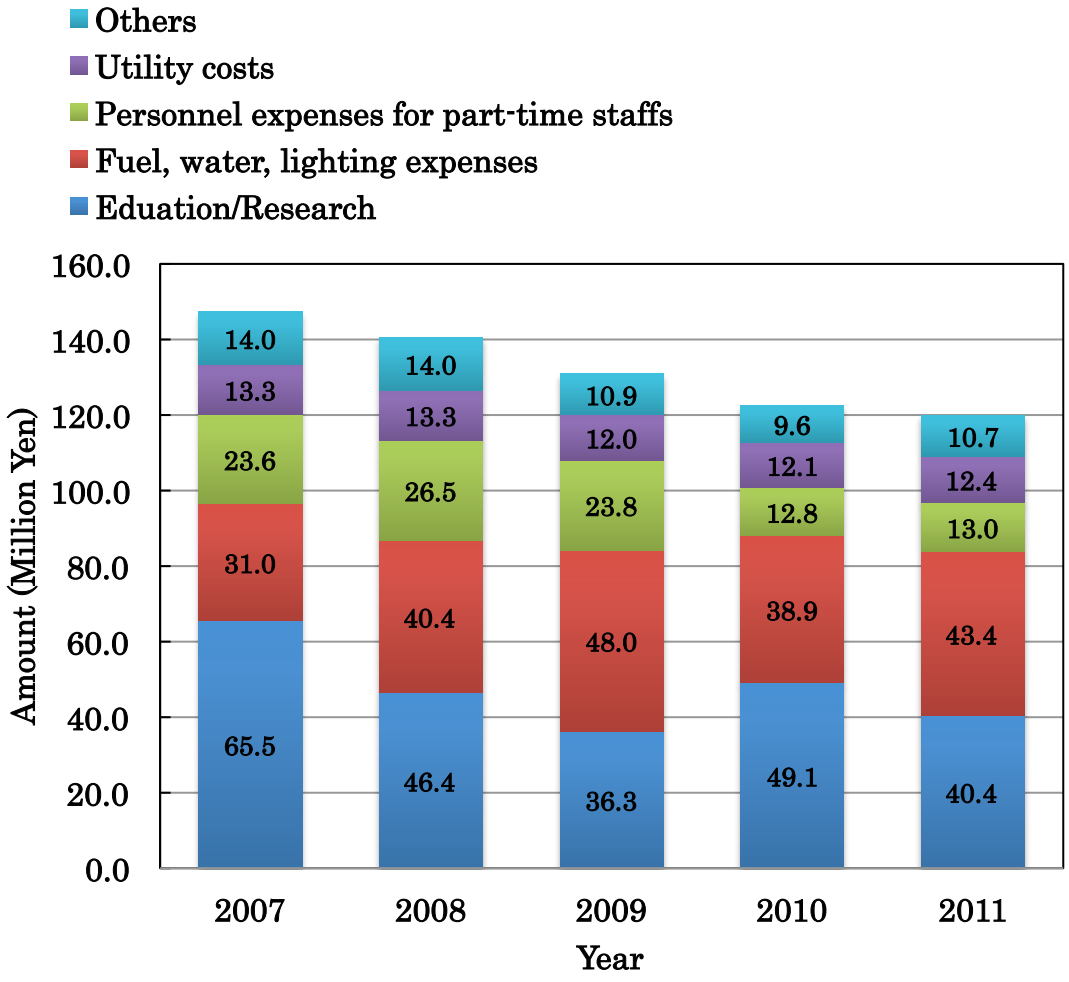
For each breakdown by categories of grants-in-aid for scientific research, please refer to each faculty member's individual documents.

	2007		2008		2009		2010		2011	
	No.	Amount	No.	Amount	No.	Amount	No.	Amount	No.	Amount
Grant-in-Aid for Scientific Research (KAKENHI)	41	193,750	38	216,653	40	194,787	43	296,435	46	417,028
Scientific Research on Innovative Areas	0	0	(4)	(39,800)	(7)	(58,870)	(9)	(119,590)	(9)	(138,220)
Scientific Research on Priority Areas	0	0	0	(1,600)	0	(1,700)	0	(1,600)	0	0
Scientific Research (S)	(2)	(32,200)	(2)	(9,000)	(1)	(6,200)	(2)	(72,900)	(3)	(151,425)
Scientific Research (A)	(7)	(72,600)	(6)	(67,350)	(6)	(45,150)	(3)	(21,045)	(3)	(66,350)
Scientific Research (B)	(12)	(60,450)	(13)	(62,050)	(11)	(43,490)	(14)	(60,150)	(10)	(35,218)
Scientific Research (C)	(9)	(12,000)	(5)	(3,800)	(7)	(7,874)	(7)	(10,200)	(9)	(7,815)
Exploratory Research	(3)	(4,200)	(2)	(1,500)	(1)	(2,000)	(2)	(2,200)	(6)	(11,150)
Young Scientists (A)	(1)	(4,000)	(1)	(8,400)	(1)	(7,300)	(1)	(3,200)	0	0
Young Scientists (B)	(7)	(7,900)	(5)	(5,800)	(6)	(7,800)	(5)	(5,550)	(3)	(3,100)
Special Purposes	0	0	0	(2,400)	0	0	0	0	0	0
Research Activity Start-up	0	0	0	0	0	0	0	0	(3)	(3,750)
Creative Scientific Research		(400)		(14,953)	0	(14,403)	0	0	0	0
Research Contracts	12	138,763	13	108,388	12	133,154	11	248,995	13	158,606
Cooperative Research	2	1,461	2	80,536	4	8,179	3	14,591	4	85,491
Global COE	0	0	0	0	1	45,000	1	45,000	1	38,100
Gifts	7	11,050	12	7,010	10	4,384	9	6,681	6	3,379
Total	62	345,024	65	412,587	67	385,504	67	611,702	70	702,604

(3) Outline of the Budgeted Expenditure (Amount in K Yen)

	2007	2008	2009	2010	2011
Education/Research	65,533	46,415	36,268	49,067	40,434
Personnel expenses for part-time staffs	23,576	26,524	23,803	12,760	12,960
Travel expenses for part-time lecturers	4,500	4,500	2,334	1,722	1,334
Library costs	3,000	3,000	2,600	1,782	3,761
Fuel, water, lighting expenses	30,950	40,371	47,981	38,900	43,350
Communication charges/Freight	1,500	1,500	1,200	1,200	1,200
Utility costs	13,323	13,287	11,964	12,088	12,360
Computer charges	4,950	4,950	4,750	4,920	4,440
Total	147,332	140,547	130,900	122,439	119,839

< Outline of the Department's Budgeted Expenditure >



III. Education

1. Education and Curriculum

(1) Objectives of Undergraduate Education

It is indispensable for scientists to have broad perspectives, deep expertise and profound understandings in order to promote researches in earth and planetary science and/or to satisfy various demands in society. Such capabilities can only be acquired through deep understanding of basic knowledge, concepts and methods. The undergraduate programs, therefore, provide education for acquiring such basics in earth and planetary science. Since it is impossible to teach basics of wide-ranging approaches in a single program, the department has set up two programs - Earth and Planetary Physics Program and Earth and Planetary Environmental Science Program; each program promotes undergraduate education through systematic curriculum so that each student is able to acquire firm basis. Earth and Planetary Physics Program puts emphasis on obtaining basic knowledge in physics and applied mathematical sciences in order for students to better understand various phenomena on the earth and planets in terms of laws of physics. On the other hand, Earth and Planetary Environmental Science Program puts emphasis on obtaining knowledge in specific targets such as materials in the earth and planets, environment and life, understanding of the basic processes arising from the historical sequence of the earth and the planetary space, and perspective to capture them integrally in order to understand the essence of complicated phenomena on the earth and planets and to extract factors which control such phenomena.

< Recent Reorganization and Improvement of Curriculum >

The department has kept putting efforts in strengthening and improving educational system in order to accomplish its educational principles. Geological Sciences Program was reorganized into Earth and Planetary Environmental Science Program in FY 2006. The department has also reinforced the structure to organize, manage and implement basic education of both programs in a unified manner. Drastic reorganization of the curriculum was conducted in Earth and Planetary Environmental Science Program to put more emphasis on field survey, observation of geological materials, as well as to include more elements of chemistry and biology relevant to earth and planetary science. Concurrently, the department also conducted curriculum reorganization of Earth and Planetary Physics Program to put emphasis on basic education of physics and applied mathematics, compliment subjects which were not covered in previous curriculums of the two programs as well as to eliminate overlapping subjects, and to strengthen the linkage between them by setting introductory and basic subjects common to both programs.

At present, among those who proceed to Earth and Planetary Environmental Science Program, there are some students who intend to comprehend environmental problems of the modern society in a narrow sense. Taking into account such demands, a number of various kinds of courses are provided by Earth and Planetary Environmental Science Program. Although this enables students to learn diversified matters and to find career opportunities in various industry sectors, there are problems such that some of the students have not studied thoroughly and are not armed with expertise and perspectives essential in the respective fields at the time of graduation. To overcome such problems, the department introduced flexible sub-course system for specialistic study in FY 2010 and has been planning to drastically renovate the curriculums since FY 2011.

On the other hand, Earth and Planetary Physics Program has reconsidered the contents of its experiments since FY 2009 and has carefully selected six crucial experiments (circuit, spectroscopy and optical measurement, vacuum, heat, polarizing microscope and elasticity.) It has thus improved

its scheme to provide systematic education on basic experimental skills regardless of whether the students are experiment-oriented or theory-oriented. Furthermore, advisory system for undergraduate students has been introduced in FY 2012 to provide detailed education by nurturing close relationship between students and faculty members. Two faculty members per student are assigned as advisors with whom students are free to consult on studies and their career/educational path.

< **Curriculum of Earth and Planetary Physics Program** >

Course Code	Course title	Teaching staff	Credit	Grade	Semester
0526002	Exercise in Basic Earth and Planetary Physics I	HOSHINO Masahiro, MIURA Akira, AMANO Takanobu	2	2	Winter
0526003	Exercise in Basic Earth and Planetary Physics II	HOSHINO Masahiro, SAKURABA Ataru, TANAKA Yuki	2	2	Winter
0526005	Introduction to Earth and Planetary Physics	SATO Kaoru, IWAGAMI Naomoto, IKOMA Masahiro, GELLER Robert	2	2	Winter
0526021	Meteorology	SATO Kaoru	2	4	Summer
0526022	Physical Oceanography	HIBIYA Toshiyuki	2	4	Summer
0526023	Physics of Ocean-atmosphere System	TOZUKA Tomoki	2	4	Winter
0526027	Earthquake Physics	IDE Satoshi, NAKATANI Masao	2	4	Summer
0526034	Mechanics of Elastic Bodies	TAKEUCHI Nozomu	2	3	Summer
0526037	Geophysical Fluid Dynamics I	IGA Keita	2	3	Summer
0526038	Geophysical Fluid Dynamics II	NIINO Hiroshi	2	3	Winter
0526065	Ocean and Atmosphere Material Circulation Physics	KOIKE Makoto, YASUDA Ichiro	2	3	Winter
0526066	Space Science I	HOSHINO Masahiro, YOKOYAMA Takaaki	2	3	Winter
0526070	Space Science II	YOKOYAMA Takaaki, IWAGAMI Naomoto, HOSHINO Masahiro, YOSHIKAWA Ichiro	2	4	Summer
0526071	Solar-Terrestrial Physics	YOSHIKAWA Ichiro, IWAGAMI Naomoto, HOSHINO Masahiro, YOKOYAMA Takaaki	2	4	Winter
0526072	Solid Earth Mechanics	OKUBO Shuhei, IMANISHI Yuichi	2	3	Winter
0526073	Exercises in Earth and Planetary Physics	TOZUKA Tomoki, SAKURABA Ataru, MIURA Akira, GENDA Hidenori	4	3	Summer
0526074	Experiments in Earth and Planetary Physics	KOIKE Makoto, ARAYA Akito, IWAGAMI Naomoto, OZAWA Kazuhito, SUGIURA Naoji, TAKAMORI Akiteru, TAKEI Yasuko, TAKEGAWA Nobuyuki, NAKATANI Masao, NAMIKI Atsuko, HIYAGON Hajime, HIRAGA Takehiko, FUNAMORI Nobumasa,	4	3	Winter

		YOSHIKAWA Ichiro, WATADA Shingo, OGAWA Tsutomu, NISHIDA Kiwamu			
0526075	Experiments in Earth and Planetary Chemistry	KOIKE Makoto, ARAYA Akito, IWAGAMI Naomoto, OZAWA Kazuhito, SUGIURA Naoji, TAKAMORI Akiteru, TAKEI Yasuko, TAKEGAWA Nobuyuki, NAKATANI Masao, NAMIKI Atsuko, HIYAGON Hajime, HIRAGA Takehiko, FUNAMORI Nobumasa, YOSHIKAWA Ichiro, WATADA Shingo, OGAWA Tsutomu, NISHIDA Kiwamu	4	3	Winter
0526076	Senior Project in Earth and Planetary Physics	Professor in charge	4	4	Summer
0526077	Senior Research in Earth and Planetary Physics	Professor in charge	4	4	Winter
0526078	Geochemistry and Cosmochemistry	HIYAGON Hajime	2	3	Winter
0526079	Material Science of Earth and Planetaty Interiors	FUNAMORI Nobumasa	2	4	Summer
0526080	Geo-electromagnetics	UTADA Hisashi, SHIMIZU Hisayoshi	2	3	Winter
0526081	Theory of Elastic Wave Propagation	GELLER Robert	2	3	Winter
0526082	Geodynamics	HONDA Satoru	2	4	Winter
0526084	Numerical Analysis in Geophysics	YOKOYAMA Takaaki, IGA Keita, GELLER Robert	2	4	Summer
0526085	Data Analysis in Geophysics	IDE Satoshi, SATO Kaoru, NAKAMURA Hisashi	2	4	Winter
0526086	Elementary Comparative Planetology	SUGITA Seiji, SEKINE Yasuhito	2	4	Summer
0526087	Elementary Earth and Planetary System Science	ABE Yutaka	2	4	Summer
0526088	Earth and Planetary System Science	ABE Yutaka	2	4	Winter
0526089	Elementary Solar-Terrestrial Physics	IWAGAMI Naomoto, YOSHIKAWA Ichiro	2	3	Summer
0526090	Observation Exercises in Earth and Planetary Physics	Professor in charge, IDE Satoshi	2	3	Summer

< **Curriculum of Earth and Planetary Environmental Science Program** >

Course code	Course title	Teaching staff	Credit	Grade	Semester
0528001	Introductory Earth Environments	KAYANNE Hajime, KONDO Yutaka	2	2	Winter
0528002	Introductory Earth System Evolution	TADA Ryuji, ENDO Kazuyoshi, KIMURA Gaku, TAJIKA Eiichi	2	2	Winter
0528003	Basic Earth and Planetary Material Science	MIKOUCHI Takashi, NAGAHARA Hiroko	2	2	Winter
0528004	Basic Geomorphology and Geology	SUGAI Toshihiko, TANAKA Hidemi	2	2	Winter
0528005	Basic Exercise on Earth and Planetary Environment I	TAJIKA Eiichi	1	2	Winter

0528006	Introduction to Regional Geography	ARAI Yoshio	2	2	Winter
0528007	Human Geography	Not offered	2	2	Winter
0528020	Lecture: Atmospheric and Oceanic Circulation	NAKAMURA Hisashi, MASUMOTO Yukio	2	3	Summer
0528021	Lecture: Paleobiology	TSUIHIJI Takanobu	2	3	Summer
0528022	Lecture: Earth and Planetary Physical Chemistry	OZAWA Kazuhito	2	3	Summer
0528023	Lecture: Solid Earth Science	OZAWA Kazuhito, IDE Satoshi, KIMURA Gaku	2	3	Summer
0528024	Lecture and Practical: Spatial Information Science	OGUCHI Takashi, HAYAKAWA Yuichi	2	3	Summer
0528025	Practical: Paleobiology	SASAKI Takenori, TSUIHIJI Takanobu	2	3･4	Summer
0528026	Practical: Geomorphology and Geology	TANAKA Hidemi, IKEDA Yasutaka, SUGAI Toshihiko, TADA Ryuji, TSUNOMORI Fumiaki	2	3	Summer
0528027	Practical: Microscopic Observation of Rock-forming Minerals	MIKOUCHI Takashi, NAGAHARA Hiroko, OZAWA Kazuhito	2	3	Summer
0528028	Basic Exercise: Earth and Planetary Environmental Science II	TAJIKA Eiichi, OZAWA Kazuhito	2	3	Summer
0528029	Field Excursion: Earth and Planetary Environmental Science I	ENDO Kazuyoshi, KIMURA Gaku	1	3	Summer
0528030	Lecture: Earth's Environmental Chemistry	KAWAHATA Hodaka, KONDO Yutaka	2	3	Winter
0528031	Lecture: Evolutionary Biology	ENDO Kazuyoshi	2	3	Winter
0528032	Lecture: Global Geochemical Cycle	TAJIKA Eiichi, OGAWA Hiroshi	2	3	Winter
0528033	Lecture: Evolution of Planetary System	NAGAHARA Hiroko	2	3	Winter
0528034	Plactical: Earth's Environmental Chemistry	URABE Tetsuro, KONDO Yutaka, SUZUKI Yohey	2	3･4	Winter
0528035	Lecture: Crystallography	MURAKAMI Takashi, KOGURE Toshihiro	2	3	Winter
0528036	Lecture and Practical: Remote Sensing	MIYAMOTO Masamichi, IKEDA Yasutaka	2	3･4	Winter
0528037	Reserch in Earth and Planetary Environmental Science	Professor in charge	4	4	Winter
0528038	Field Exercise: Earth and Planetary Environmental Science I	TADA Ryuji, TSUIHIJI Takanobu, TAKAHASHI Satoshi	2	3	Summer
0528039	Field Exercise: Earth and Planetary Environmental Science II	KAYANNE Hajime, IKEDA Yasutaka	2	3	Summer
0528040	Field Exercise: Earth and Planetary Environmental Science III	OZAWA Kazuhito, IIZUKA Takeshi, KOYAGUCHI Takehiro	2	3	Summer
0528041	Practical: Earth and Planetary Environmental Science	TADA Ryuji	2	3	Winter
0528042	Field Excursion: Earth and Planetary Environmental Science II	Not offered	1	3	Winter
0528043	Exercise: Earth and Planetary Environmental Science	Professor in charge	2	4	Summer
0528044	Field Excursion: Earth and Planetary Environmental Science III	YOKOYAMA Yusuke	1	3	Winter
0528045	Lecture and Practical: Biodiversity Science	SUZUKI Yohey, SASAKI Takenori, TSUIHIJI Takanobu,	2	3･4	Summer

		SUNAMURA Michinari			
0528046	Lecture and Practical: Geo-ecology	KAYANNE Hajime, SASAKI Takenori	2	3・4	Summer
0528047	Exercise: Physical Chemistry in Earth and Planetary Science	SHIMIZU Ichiko, OZAWA Kazuhito	2	3・4	Summer
0528048	Practical: Analyses of Rock Textures I	NAGAHARA Hiroko, SHIMIZU Ichiko	2	3・4	Summer
0528049	Practical: Analyses of Rock Textures II	TADA Ryuji, OGIHARA Shigenori, TAKAHASHI Satoshi	2	3・4	Summer
0528050	Lecture: Human and Environment System	ANAZAWA Katsuro	2	3	Summer
0528051	Lecture: Stratigraphy and Geochronology	ENDO Kazuyoshi, NAKAI Shun'ichi, IIZUKA Takeshi	2	3	Summer
0528053	Lecture: Plate Tectonics	KIMURA Gaku, OKINO Kyoko, KATO Teruyuki	2	3	Winter
0528054	Lecture: Basic Climatology	WATANABE Masahiro, TAKAYABU Yukari	2	4	Summer
0528055	Lecture: Paleoclimatology and Paleoceanography	TADA Ryuji, YOKOYAMA Yusuke	2	4	Summer
0528056	Lecture: Sedimentology	TADA Ryuji, KOMIYA Tsuyoshi	2	4	Summer
0528057	Lecture: Analyses of Earth and Planetary Material	KOGURE Toshihiro, KAGI Hiroyuki	2	4	Summer
0528058	Lecture: Structural Geology	KIMURA Gaku, TANAKA Hidemi	2	4	Summer
0528059	Lecture: Geomorphology	IKEDA Yasutaka, SUGAI Toshihiko	2	4	Summer
0528060	Lecture: Volcanology and Magmatology	KOYAGUCHI Takehiro, IIZUKA Takeshi	2	4	Summer
0528061	Practical: Crystallography	MIKOUCHI Takashi, KOGURE Toshihiro, MURAKAMI Takashi	2	3	Winter
0528062	Lecture: Earth History	TAJIKA Eiichi, TADA Ryuji	2	4	Winter
0528063	Lecture: Paleontology	ENDO Kazuyoshi	2	4	Winter
0528064	Lecture: Introduction to Advanced Mineralogy	MURAKAMI Takashi, SUZUKI Yohey, MIKOUCHI Takashi	2	4	Winter
0528065	Lecture: Planetary Geology	MIYAMOTO Hideaki, KURITA Kei	2	4	Winter
0528066	Aquatic Science	YAMAMURO Masumi	2	3	Winter
0528067	Conservation of Museum Collections	KUCHITSU Nobuaki	2	3・4	Summer

(2) Objectives of Graduate Education

As stated earlier, educational objectives of the graduate programs at the Department of Earth and Planetary Science are to foster researchers with broad perspectives, deep expertise, international sense and creativity, as well as science engineers who can satisfy various social demands through wide and firm technical knowledge. In order to attain such objectives, based on education during the undergraduate programs, two years of master's program, or three years including the first year of doctorate program, are used to acquire basic knowledge common to all areas of earth and planetary science as well as basic knowledge of specific research fields that is essential to students' spontaneous researches. Three years of doctorate program are used to nurture originality and creativity that are essential to promote cutting-edge sciences.

Since more than 60% of master's students get undergraduate degrees from institutions other than the two undergraduate programs without any academic trainings in related fields, the department offers introductory courses in the master's program so that even the students with no background of earth and planetary science can acquire basic knowledge common to all the specific fields of earth and planetary science. On the other hand, selected and arranged basic courses together with higher specific and advanced courses such as special lectures are provided so that students can systematically acquire basic knowledge in the specific fields that is necessary for conducting advanced research in the doctorate program. The department thus aims to attain the educational objectives by fostering students with broad perspectives and expertise based on deep understanding of basic concepts and methods.

Furthermore, courses can be selected systematically depending on each student's career or educational path. That is, two courses are provided in the master's program. One is for students who aim to proceed to the doctorate program and become researchers, emphasizing advanced classes, whereas the other is for students who aim to become science engineers, emphasizing a wide range of basic classes. Each master's thesis is presented and defended in front of more than ten faculty members at the department-wide defense and is closely reviewed by three faculty members in related fields including his/her academic advisor.

As is evident in the table below, courses provided by the curriculum of the graduate programs are extremely numerous, partly because the department covers such wide areas. Although the curriculum is more organized compared to that at the time the department was established in 2000, as can be seen in, for example, assigning several faculty members to a single course to teach in turns, the quality of the curriculum should be maintained and improved through continuously checking duplication of courses, contents of the lectures and the number of attendees.

Education in the doctorate program aims to encourage flexible and creative way of thinking based on broad perspectives and deep knowledge in specific research fields acquired during the master's program and, through small-group seminars and instructions, to develop researchers who have capability of carrying out their original researches and presenting and discussing the results in the international community. In order to attain this objective, the department places a special emphasis on seminars and colloquiums in its doctorate curriculum so as to effectively extract autonomy of students.

As part of the Global COE program, the department hires excellent native speakers with abundant experience in English education to offer English courses to first- and second-year students and support them in writing English papers for publication. The English course started as part of the 21st Century Center of Excellence (COE) program and has developed into three courses: a beginner course which is dictation-based, an intermediate course which teaches conversation in addition to dictation, and an advanced course which focuses on debates and presentations in English. The education of these courses has been successful in achieving their respective educational aims.

It is required for students to publish at least one first-authored paper in English in an international journal before submitting a doctoral dissertation as part of training of presenting results of research to the international scientific community. Doctoral candidate's academic advisor cannot be the chief examiner in the theses review board and the preliminary defense is held in public where not only faculty members but also other students are allowed to attend. Each dissertation is thus closely reviewed in a fair and objective manner.

The number of students proceeding to the doctorate program has been decreasing over the past few years. It is crucial to maintain the quality of education and research environment so that the students would not hesitate to proceed to the doctorate program as well as to resolve several issues regarding postdoctoral fellows and to enhance financial support and job assistance.

< **Curriculum of the Graduate Programs** >

Course Code	Course title	Teaching staff	Credit	Semester	Category
35616-0001	Time Series Analysis	Miyatake Takashi	2	Winter	B
35616-0002	Geophysical Data Analysis *	IDE Satoshi, SATO Kaoru, NAKAMURA Hisashi	2	Winter	B **
35616-0003	Mathematical Methods in Geophysics	SHINOHARA Masanao, YAMANO Makoto	2	Summer	B
35616-0004	Numerical Analysis in Geophysics	YOKOYAMA Takaaki, IGA Keita, GELLER Robert	2	Summer	B **
35616-0005	Mechanics of Elastic Body	TAKEUCHI Nozomu	2	Summer	B **
35616-0006	Solid Earth Mechanics	OKUBO Shuhei, IMANISHI Yuichi	2	Winter	B **
35616-0007	Geophysical Fluid Dynamics I	IGA Keita	2	Summer	B **
35616-0008	Geophysical Fluid Dynamics Ⅱ	NIINO Hiroshi	2	Winter	B **
35616-0009	Material Science of the Earth and Planetary Interiors	FUNAMORI Nobumasa	2	Summer	B **
35616-0010	Stratigraphy and Geochronology	ENDO Kazuyoshi, NAKAI Shun'ichi, IIZUKA Takeshi	2	Summer	B **
35616-0013	Elementary Solar-Terrestrial Physics	IWAGAMI Naomoto, YOSHIKAWA Ichiro	2	Summer	B **
35616-0014	Elementary Comparative Planetology	SUGITA Seiji, SEKINE Yasuhito	2	Summer	B **
35616-0015	Elementary Earth and Planetary System Science	ABE Yutaka	2	Summer	B **
35616-0021	Plate Tectonics	KIMURA Gaku, OKINO Kyoko, KATO Teruyuki	2	Winter	B **
35616-0022	History of the Earth	TAJIKA Eiichi, TADA Ryuji	2	Winter	B **
35616-0023	Solid Earth Science	OZAWA Kazuhito, KIMURA Gaku, IDE Satoshi	2	Summer	B **
35616-1001	Atmospheric Physics Ⅰ	NAKAJIMA Teruyuki	2	Summer	A
35616-2002	Atmospheric Physics Ⅳ	SATO Kaoru, TAKAHASHI Masaaki	2	Winter	A
35616-1003	Physical Oceanography Ⅰ	HIBIYA Toshiyuki, NIWA Yoshihiro	2	Winter	A
35616-1004	Physical Oceanography Ⅱ	OKA Eitaro	2	Summer	A
35616-1005	Climate Dynamics Ⅰ	MASUMOTO Yukio	2	Winter	A
35616-1007	Ocean-Atmosphere Material Circulation Physics I	KOIKE Makoto, KONDO Yutaka, TAKAHASHI Masaaki	2	Summer	A
35616-2008	Ocean-Atmosphere Material Circulation Physics Ⅲ	YASUDA Ichiro, UEMATSU Mitsuo	2	Winter	A
35616-1008	Space Plasma Physics I	YOKOYAMA Takaaki	2	Winter	A
35616-1009	Physics of Magnetosphere I	HOSHINO Masahiro	2	Summer	A
35616-2013	Planetary Exploration Science I	IWAGAMI Naomoto, YOSHIKAWA Ichiro	2	Summer	A
35616-2014	Planetary Exploration Science Ⅱ	IMAMURA Takeshi	2	Winter	A
35616-2015	Comparative Planetology Ⅰ	SUGIURA Naoji	2	Summer	A

35616-2017	Cosmic and Planetary Material Science I	MIYAMOTO Masamichi, MIKOUCHI Takashi	2	Winter	A
35616-1013	Earth and Planetary System Science	ABE Yutaka	2	Winter	A **
35616-1014	Theory of Solar System Formation I	NAGAHARA Hiroko, IKOMA Masahiro	2	Summer	A
35616-1020	Theory of Geochemical Cycle	NAKAI Shun'ichi, SANO Yuji	2	Winter	A
35616-1053	Introduction to Ocean-Atmosphere Circulation	NAKAMURA Hisashi, MASUMOTO Yukio	2	Summer	A **
35616-1054	Ocean-Atmospheric Chemistry	KONDO Yutaka	2	Winter	A
35616-2025	Geographical Information Science	OGUCHI Takashi	2	Summer	A
35616-1055	Elementary Climatology	WATANABE Masahiro, TAKAYABU Yukari	2	Summer	A **
35616-1057	Paleoclimatology/Paleooceanography	TADA Ryuji, YOKOYAMA Yusuke	2	Summer	A **
35616-1060	Theory of Earth and Planetary Environmental Evolution	TAJIKA Eiichi	2	Summer	A
35616-1022	Seismic Wave Theory I	KAWAKATSU Hitoshi, IWASAKI Takaya	2	Summer	A
35616-1023	Theory of Earth's Internal Structure	UESHIMA Makoto, HIRAGA Takehiko, TAKEUCHI Nozomu	2	Winter	A
35616-1071	Geodynamics of Earth's Interior	HONDA Satoru	2	Winter	A **
35616-1025	Geo-electromagnetics	UTADA Hisashi, SHIMIZU Hisayoshi	2	Winter	A **
35616-1026	Magma Science	IIZUKA Takeshi	2	Winter	A
35616-1027	Elementary Volcanology	KOYAGUCHI Takehiro, NAKADA Setsuya, OMINATO Takao	2	Summer	A
35616-1028	Plate-Boundary Zone Tectonics	KIMURA Gaku, MIURA Satoshi	2	Summer	A
35616-1029	Earth's Rheology	TAKEI Yasuko, HIRAGA Takehiko	2	Summer	A
35616-1030	Ocean Floor Dynamics	OKINO Kyoko	2	Winter	A
35616-1031	Theory of Geomorphic Evolution	IKEDA Yasutaka	2	Winter	A
35616-1033	Earthquake Physics	IDE Satoshi, NAKATANI Masao	2	Summer	A **
35616-1034	Physics of Earthquake Generation	KAME Nobuki, TANAKA Hidemi	2	Winter	A
35616-1063	Methodology of Solid Earth Observation	IIDAKA Takashi, SAKAI Shin'ichi, MORITA Yuichi, SHIMA Makoto, KATO Teruyuki, SHIOBARA Hajime, OKUBO Shuhei, YAMANO Makoto, URABE Taku, ARAYA Akito, MIURA Satoshi	2	Summer	A
35616-1040	Theory of Biospheric Environmental Evolution	KAWAHATA Hodaka	2	Winter	A
35616-1041	Analysis of Biosphere Materials	KOGURE Toshihiro	2	Summer	A
35616-1064	Evolutionary History of Life on Earth	TSUIHIJI Takanobu	2	Summer	A **
35616-1065	Evolutionary Biology	ENDO Kazuyoshi	2	Winter	A **

35616-1066	Earth's Environmental Chemistry	KAWAHATA Hodaka, KONDO Yutaka	2	Winter	A **
35616-2057	Programming for Parallel Computing	NAKAJIMA Kengo	2	Summer	F
35616-2059	Theory of Climate Change Prediction Ⅰ	KIMOTO Masahide	2	Summer	F
35616-3001	Special Lecture of Oceanic and Atmospheric Science Ⅰ	MASUDA Akira	1	Winter	S
35616-2041	Special Lecture of Oceanic and Atmospheric Science V	ITO Hisanori	1	Summer	S
35616-3005	Special Lecture of Space and Planetary Science Ⅰ	NAKAMURA Masato	1	Summer	S
35616-3006	Special Lecture of Space and Planetary Science Ⅱ	FUJIMOTO Masaki	1	Winter	S
35616-3007	Special Lecture of Space and Planetary Science Ⅲ	HADA Toru	1	Winter	S
35616-3009	Special Lecture of Earth and Planetary System Science Ⅰ	NAKAGAWA Takeshi	1	Summer	S
35616-3013	Special Lecture of Solid Earth Science Ⅰ(High Energy Earth and Planetary Science)	TANAKA Hiroyuki	1	Summer 2nd Half	S
35616-3015	Special Lecture of Solid Earth Science Ⅲ (Frictional Laws and Various Slip Modes)	YOSHIDA Shingo	1	Winter 1st Half	S
35616-3016	Special Lecture of Solid Earth Science Ⅳ	KAME Nobuki	1	Summer	S
35616-2047	Special Lecture of Solid Earth Science Ⅴ (Geothermics)	YAMANO Makoto	1	Winter 2nd Half	S
35616-2048	Special Lecture of Solid Earth Science Ⅵ (Probabilistic and Statistical Seismology)	YAMASHINA Kenichiroo	1	Summer 1st Half	S
35616-4001	Field Work in Earth Science	URABE Tetsuro, ITO Tanio	1	Summer	E
35616-4002	Laboratory Experiments for Geophysical Observation	IIDAKA Takashi, SAKAI Shin'ichi, MORITA Yuichi, UESHIMA Makoto, KATO Teruyuki, SHIOBARA Hajime, YAMANO Makoto, URABE Taku, MOCHIZUKI Kimihiro, MIURA Satoshi	1	Summer	E
35616-4014	English for Scientific Researchers (English for Scientific Researchers Ⅲ)	GELLER Robert	2	Full Year	E
35616-4009	Exercise of Advanced Computer Science Ⅰ	NAKAJIMA Kengo	1	Summer	E
35616-5001	Seminar of Current Scientific Literature Ⅰ	Professor in charge	2	2 years	C
35616-5007	Seminar of Current Scientific Literature Ⅱ	Professor in charge	2	3 years	C
35616-5003	Earth and Planetary Science Colloquium Ⅰ	Professor in charge	2	2 years	C
35616-5008	Earth and Planetary Science Colloquium Ⅱ	Professor in charge	2	3 years	C
35616-5005	Research in Earth and Planetary Science I	Professor in charge	10	2 years	C
35616-5006	Research in Earth and Planetary Science Ⅱ	Professor in charge	10	3 years	C

35616-6001	Seminar in Marine Affairs	Professor in charge	4	Full Year	O
35616-6002	Basic Ocean Sciences	URABE Tetsuro	2	Winter	O
35616-7001	GCOE Earths Special Lecture 4	IKOMA Masahiro	1	Summer	GCOE
35616-7002	GCOE Earths International Lecture 3	J. Kasting	1	Winter	GCOE

Category; A: Advanced courses, A**: Advanced courses shared with Undergraduate Programs, B: Basic courses, B**: Basic courses shared with Undergraduate Programs, F: Frontier science course, S: Special lectures, E: Exercises and Experiments, C: Compulsory Courses, O: Interdisciplinary Education Program on Ocean Science and Policy (UT Ocean Alliance), GCOE: GCOE "from the Earth to 'Earths'"Special Education Course

(3) GCOE Program "from the Earth to 'Earths'" : Interdisciplinary Study on Habitable Planets

< Objectives of Habitable Planet Special Education Course >

The department promotes Global COE program "from the Earth to Earths'": Interdisciplinary study on habitable planets (GCOE Earths) in cooperation with Tokyo Institute of Technology. The mission of ongoing research and education of GCOE Earths is to construct new perspectives of the world based on the understanding of earth and life through integration of earth and planetary science (theory of planet formation, geology, physical chemistry of earth's internal materials, geochemistry and cosmochemistry, theory of climate change and environmental chemistry), astronomy (astrophysics and observational astronomy) and biological sciences (genomic science and plant biochemistry.) Through its Habitable Planet Special Education Course established in FY 2010, GCOE Earths aims to foster researchers who understand and materialize educational and research themes of the program. The course helps individuals to obtain advanced technical knowledge essential for researchers, and at the same time, aims to foster young researchers who can play a central role in a new science called habitable planet life planetology as leaders of education, research development and technology development.

The department selects and supports about 15 doctoral students every year as members of Habitable Planet Special Education Course, sends about 10 doctoral students every year to international conferences, and invites specialists in various research fields from overseas to give intensive lectures. Through such activities, the program aims to foster young researchers with interdisciplinary perspective, international sense and ability to take action in science.

< Curriculum of Global COE program "from the Earth to 'Earths'" >

Course Title	Place	Teaching Staff	Credit	Semester
GCOE Earths Colloquium	Tokyo Inst. of Tech.	Ida, Omori	1	Winter
GCOE Earths Status Report	Univ. Tokyo	Nagahara	1	Winter
GCOE Earths Internship	Univ. Tokyo	Nagahara	4	Winter
GCOE Earths Special Lecture 1	Tokyo Inst. of Tech.	Ida, Nakamoto	1	Summer
GCOE Earths Special Lecture 2	Tokyo Inst. of Tech.	Yoshida, Abe, Maruyama	1	Winter
GCOE Earths Special Lecture 3	Tokyo Inst. of Tech.	Maruyama	1	Summer
GCOE Earths Special Lecture 4	U. Tokyo (Grad. School of Science)	Ikoma	1	Winter
GCOE Earths Special Lecture 5	Tokyo Inst. of Tech.	Ota, Maruyama	1	Summer
GCOE Earths Special Lecture 6	Univ. Tokyo (Grad. School of Arts &	Ikeuchi, Isozaki	1	Winter

	Sciences)			
GCOE Earths International Lecture 1	Tokyo Inst. of Tech.	Meriem EL Karoui	1	Summer
GCOE Earths International Lecture 2	Tokyo Inst. of Tech.	Tristan Guillot	1	Winter
GCOE Earths International Lecture 3	U. Tokyo (Grad. School of Science)	James Kasting	1	Winter
GCOE Earths International Lecture 4	U. Tokyo (Grad. School of Arts & Sciences)	Zhang Xiang Liang	1	Winter
GCOE Earths International	Univ. Tokyo	Nagahara	1	Winter
GCOE Earths Tutorial	Univ. Tokyo	Nagahara	1	Winter
GCOE Earths Outreach	Univ. Tokyo	Nagahara	1	Winter

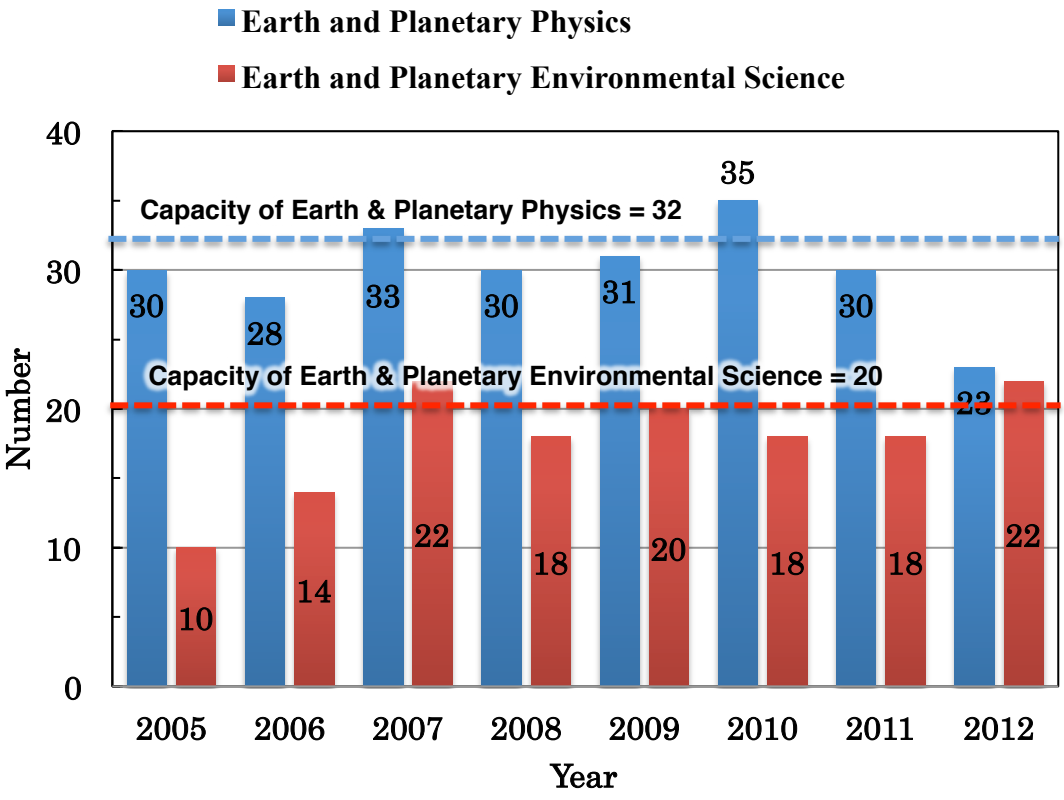
U. Tokyo; Univ. Tokyo: The University of Tokyo, Tokyo Inst. of Tech.: Tokyo Institute of Technology

2. Changes in the Number of Students

The capacity of students in the department is as follows: 109 for master's program, 53 for doctorate program, 32 for Earth and Planetary Physics undergraduate program and 20 for Earth and Planetary Environmental Science undergraduate program.

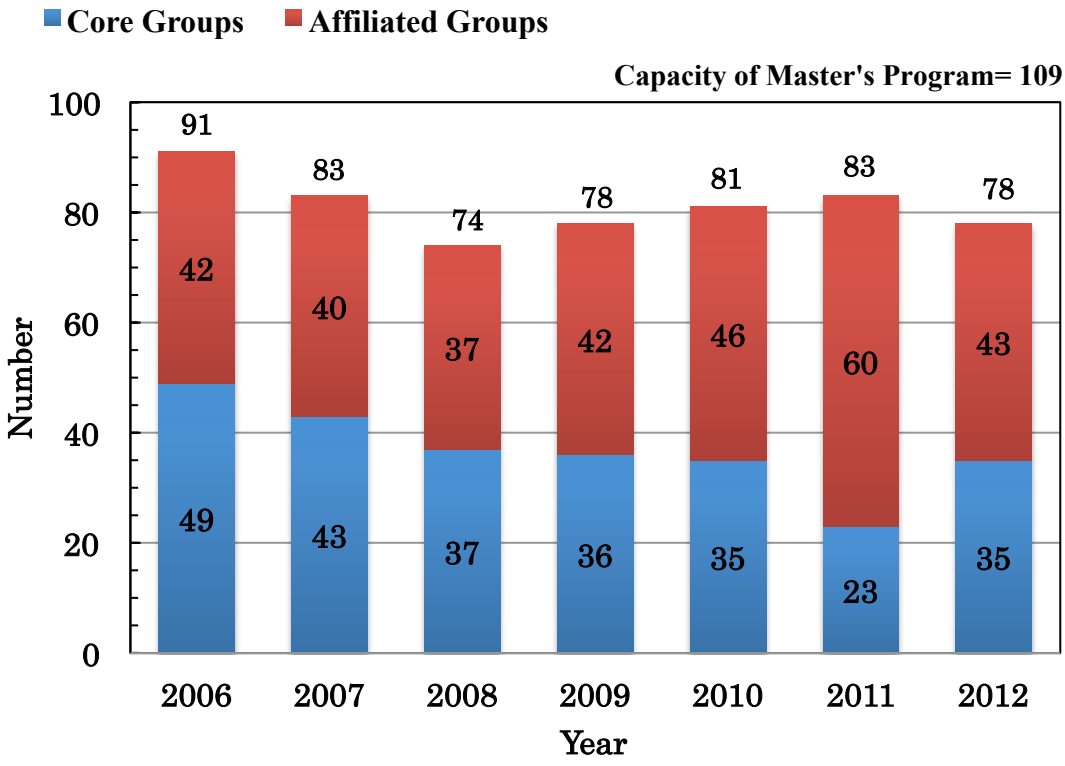
The number of undergraduate students proceeding from Junior Division to Senior Division in the third year is shown below for each undergraduate program. The enrollments in master's and doctorate programs are also shown below, sorted by the core and affiliated groups and by students from within (Earth and Planetary Physics / Earth and Planetary Environmental Science Programs) and outside (other programs in the University of Tokyo / other universities) the department.

(1) The Number of Undergraduate Students Proceeding from Junior to Senior Division

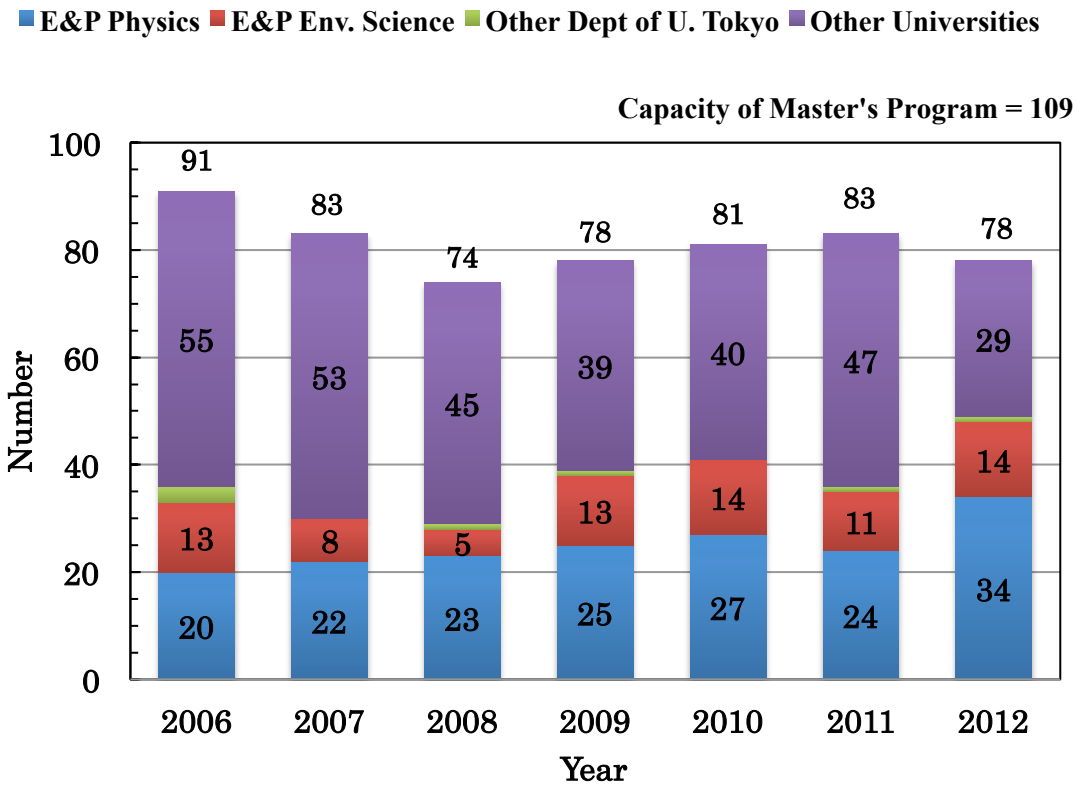


(2) Enrollment in Master's Program

< Enrollment in Master's Program Sorted by Core Groups and Affiliated Groups >



< Enrollment in Master's Program Sorted by Students from within (E&P Physics and E&P Env. Science) and outside the Department (Univ. Tokyo and other universities) >

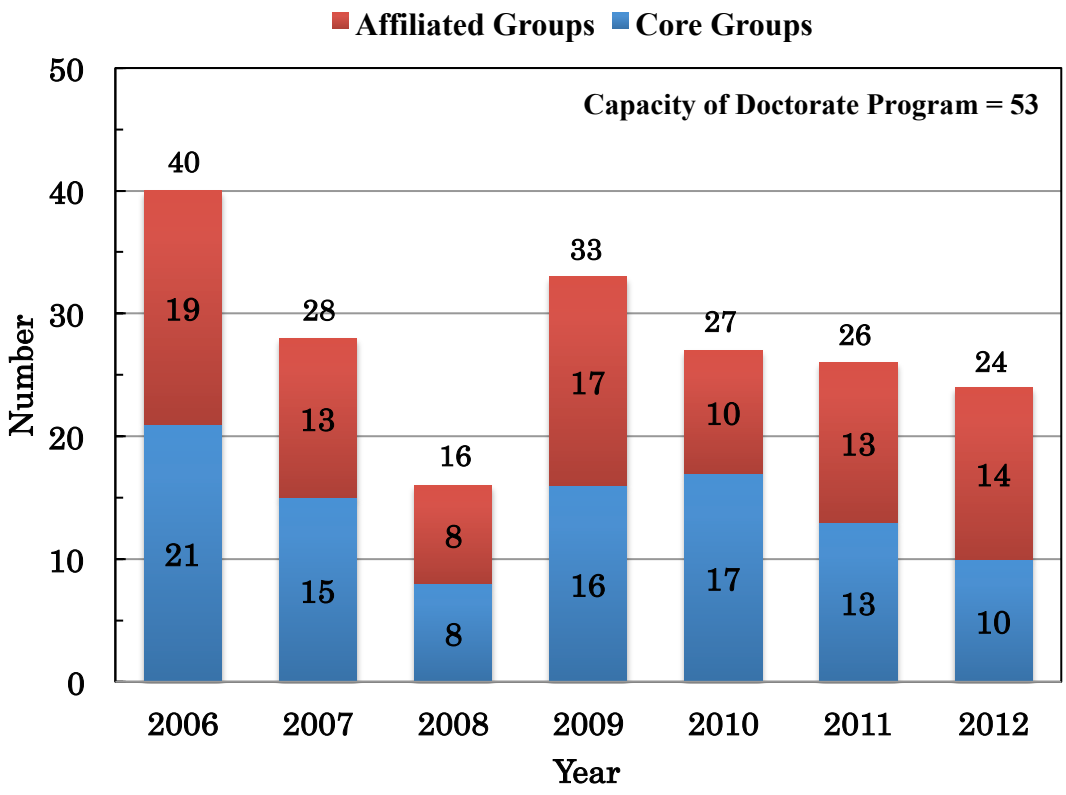


The enrollment in master's program has been fluctuating around 80 or so in the past few years. Although the figure is significantly small compared to the capacity of 109 students, it can be said to be reasonable to some extent considering academic abilities of successful candidates and the number of graduate students engaged in earth and planetary science in Japan. Recently, students belonging to the affiliated groups have outnumbered those belonging to the core groups. Although it has long been a problem that the enrollment from outside the university had been much higher than that from Earth and Planetary Physics Program and Earth and Planetary Environmental Science Program (enrollment from within the department), almost half of the enrolled students have proceeded from within the department in the past few years.

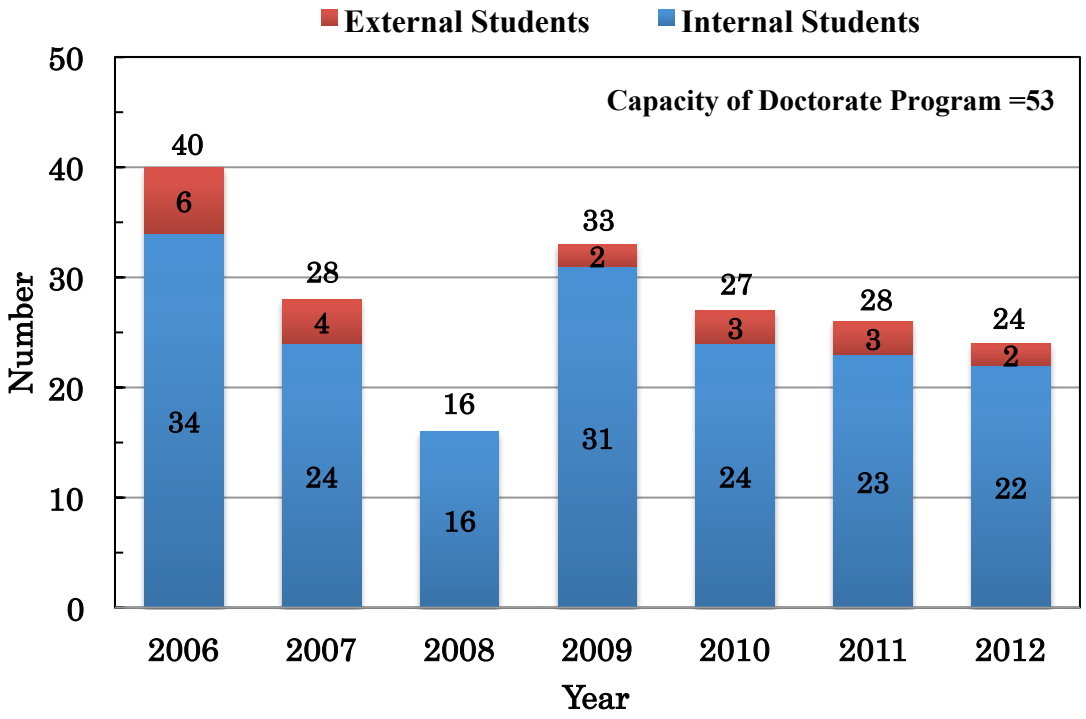
(3) Enrollment in Doctorate Program

The enrollment in doctorate program has been decreasing in the past six years, with about 25 students every year. The figure is significantly small compared to the capacity of 53 students. The enrollments in the core groups and affiliated groups vary from year to year but are about the same. Unlike in the case of master's program, most of the students in the doctorate program are those proceeded from the master's program in the department, and those from outside the department are several or less every year. Therefore, decreased enrollment in the doctorate program is a result of decreased enrollment from within the department.

< Enrollment in Doctorate Program Sorted by Core Groups and Affiliated Groups >

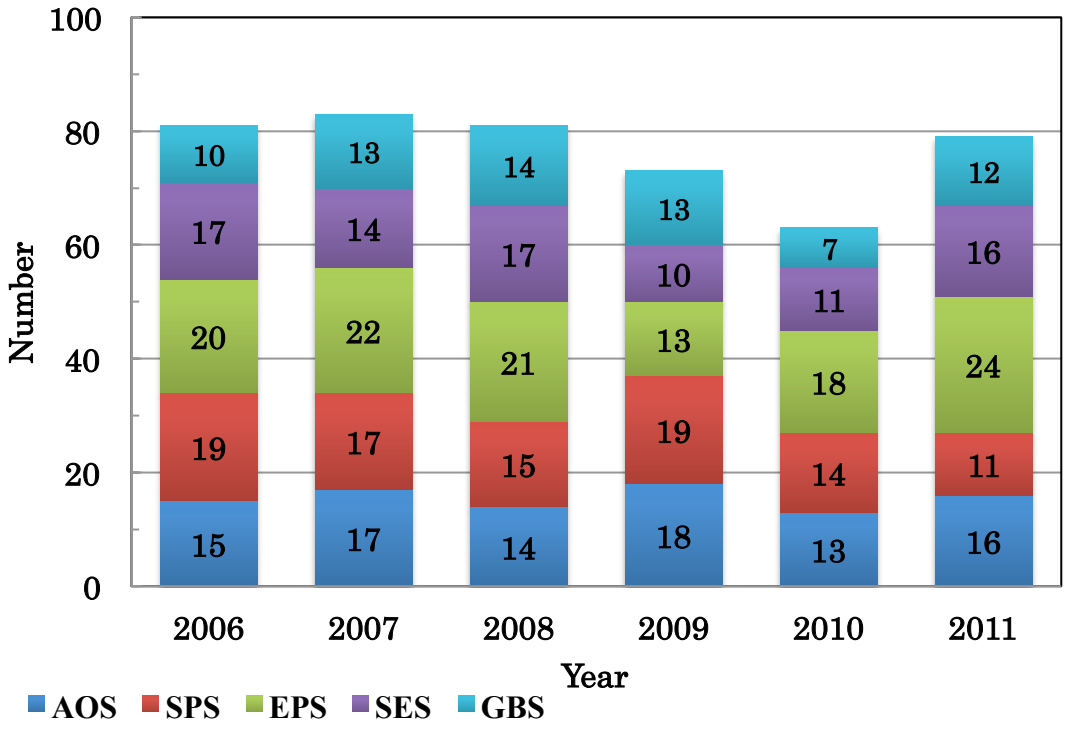


< Enrollment in Doctorate Program Sorted by Students from within and outside the Department >



3. Master's Theses and Doctoral Dissertations

(1) Changes in the Number of Master's Theses Sorted by Groups



AOS: Atmospheric and Oceanic Science, SPS: Space and Planetary Science, EPS: Earth and Planetary System Science, SES: Solid Earth Science, GBS: Geosphere and Biosphere

(2) List of Master's Theses (FY 2011)

Date	Name	Title	Aff.
2011/9/27	TAKANO Issei	Global characteristics of vertical wave spectrum based on high-resolution climate model data	CORE
2011/9/27	MURAKAMIYasutaka	Generation environment and mechanism of cyclones in Baiu front zone	AORI
2012/3/22	AOKI Kenji	Sedimentation process of coral debris on coral reefs: a case study at Barasu Island, northwest Iriomote Island.	CORE
2012/3/22	UEMURA Kota	Angular dependence of the solar wind protons scattered at the lunar surface	JAXA
2012/3/22	ENOMOTO Yoshiyasu	Numerical study on spatial dependence of internal wave spectrum in hotspots of turbulent mixing and verification of turbulent mixing parameterization	CORE
2012/3/22	KURIHARA Yoshiharu	Statistical analysis of seismicity by discretized triggering model	CORE
2012/3/22	SHIOMI Yuya	Asymmetry of a shear zone in brittle / ductile regime	CORE
2012/3/22	SHIMIZU Asa	Variations of aerosol size distribution caused by coagulation: Analysis based on airborne BC observation data in East Asia	CORE
2012/3/22	SOMEYA Naoyuki	Geology and origin of tungsten-skarn deposit in Nui Phao, northern Vietnam	CORE
2012/3/22	HIGASHI Masayuki	Regional distribution and depositional history of the incoming sediments in the Nankai Trough	AORI
2012/3/22	MATSUBARA Kosuke	On the oceanic cooling process in the southeastern tropics during the development phase of the 2006 Indian Ocean Dipole	CORE
2012/3/22	MATSUYAMA Takeshi	Analysis of Size, Geometry, and Motion of Plates	CORE
2012/3/22	MIMURA Toshihiro	Shell growth pattern of three bivalve species living in the subtidal environment around Hokkaido, Japan: Its ecological and paleoecological implications	CORE
2012/3/22	AIBA Yurie	Reconstruction of nitrogen environment in coastal zone using nitrogen stable isotope values of Halimeda spp.	CORE
2012/3/22	ASO Naofumi	Intraplate Deep Low Frequency Earthquakes far from Active Volcanoes	CORE
2012/3/22	ARAI Hiroaki	Dependence of momentum transport by thermal tides on the atmospheric structure on Venus	JAXA
2012/3/22	IIZUKA Yuma	UV Absorption material hight distribution deduced from the Venus's cloud images	JAXA
2012/3/22	IZUMI Kentaro	Palaeoenvironmental and ichnological studies of the Toarcian (Early Jurassic) black shales from Toyora area, west Japan and Dotternhausen area, south Germany	CORE
2012/3/22	ISOBE Masako	Non-crystal calcium carbonate and its structure in the exoskeleton of the terrestrial crustacean *Armadillidium vulgare*	CORE
2012/3/22	ITO Kaori	Reconstruction of environmental changes in the bottom layer of Joetsu Oceanic Basin on the eastern margin on Sea of Japan in the past 10,0000 years based on the sedimentary facies and sulfur isotopic ratio	CORE
2012/3/22	OTA Mai	Roles of intraseasonal disturbances and diabatic heating in formation of anomaly patterns associated with East Asian winter monsoon	AORI
2012/3/22	OTA Yoshihiro	Hydrogen isotopic composition of phosphate and elemental distribution in Martina meteorites	AORI

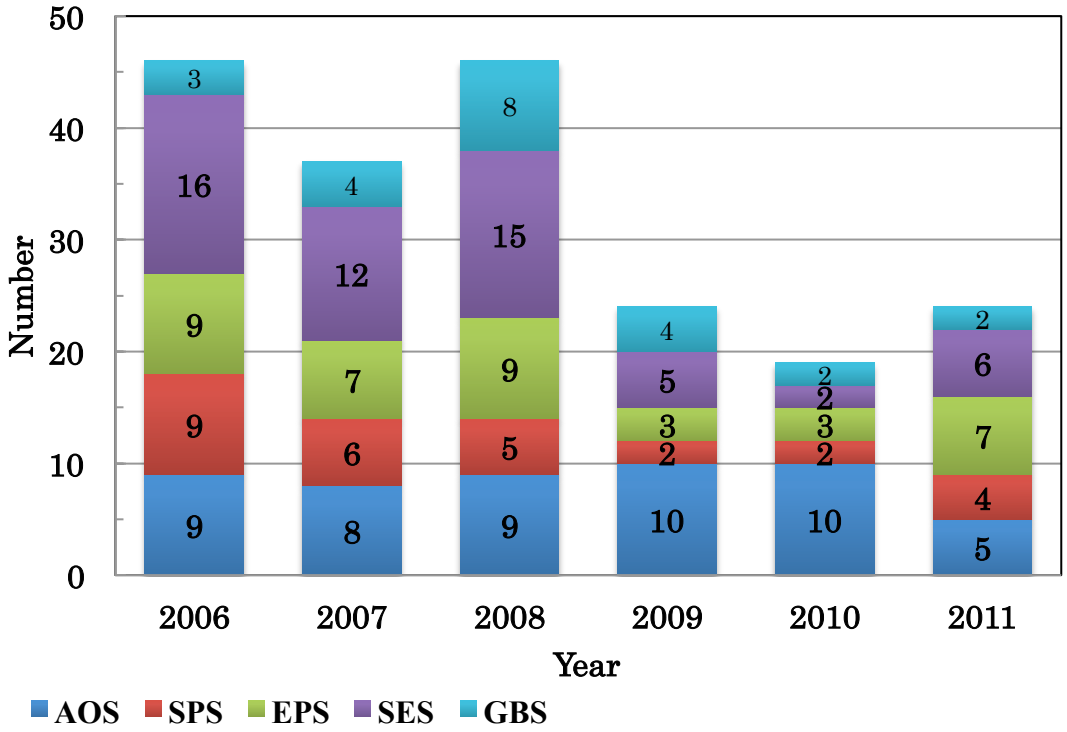
2012/3/22	OHATA Sho	Development of the method to measure black carbon particles in rain water and its application to the observations in Tokyo and Okinawa Island	CORE
2012/3/22	OCHIAI Sho	Effects of Source Area Properties on Alluvial Fan Morphology	CSIS
2012/3/22	KATAOKA Takahito	The Indian Ocean subtropical dipole mode simulated in the CMIP3 models	CORE
2012/3/22	KATAYAMA Miyuko	Relationship between heavy metal contamination and nitrogen saturation in Chichibu region, Saitama Prefecture	GSFS
2012/3/22	KATO Tomoya	Surface micro-topography of the crystal plane in titanium dioxide formed under high temperature	CORE
2012/3/22	KAWAZOE Yasuyuki	Source fault and rupture process of the 2006 Yogyakarta earthquake	ERI
2012/3/22	KUBOTA Kaoru	Sea surface pH reconstruction using boron isotope composition of coral skeleton during last deglaciation at Central sub-Equatrial Pacific	AORI
2012/3/22	KODAMA Takanori	Evolution of terrestrial planets with water loss and re-evaluation of the inner edge of the Habitable zone	CORE
2012/3/22	KOBAYASHI Hiroshi	Reproducibility of the rain front by a climate model and the role of lateral thermal advection	RCAST
2012/3/22	KONDA Shunsuke	Relation between the 18.6-year tidal cycle and sea temperature/pressure fields: Impacts on the Pacific low-latitudes	AORI
2012/3/22	SAITO Tatsuhiko	Simulation study on stability of cosmic ray modified shocks	CORE
2012/3/22	SAKAI Koichi	Study for the electric field imposed on the inner magnetosphere based on the measurements of satellite remote sensing and ground-based magnetometers.	CORE
2012/3/22	SAKAGUCHI Koichi	Time spectra of the geomagnetic field at the CMB and MHD flow in the core	ERI
2012/3/22	SAKASHITA Wataru	Causal Link between Solar Magnetic Variability and East Asian Climate Anomalies during the Maunder Minimum	AORI
2012/3/22	SASAKI Shogo	Ion microprobe studies of Al-Mg isotopes on hibonite-bearing inclusions from the Murchison meteorite.	CORE
2012/3/22	SATO Hirotaka	Seasonal cloudiness variation in the warm period of northwestern Pacific region and its secular change	RCAST
2012/3/22	SHOJI Daigo	Reconsideration of Enceladus' tidal heating from the aspect of ice rheology and internal structure	ERI
2012/3/22	SUMIYOAHI Seiichiro	Response of continental carbon cycle against climate change in recent 100 years	AORI
2012/3/22	TAKADA Hiroto	Compression behavior of densified SiO_2 glass	CORE
2012/3/22	TAKAHASHI Yoshiaki	An analysis of the blocking over western Russia in 2010 summer	AORI
2012/3/22	TAWARA Kentarou	Reconstruction of oceanic environment of middle holocene and the middle age from the coral skeleton of Maldive, Indian Ocean	AORI
2012/3/22	TSUBAKI Haruka	Iron nanomineral and its effects on transport of a heavy metal	CORE
2012/3/22	TOKUMARU Ayaka	Temporal and depth variation in trace element contents and osmium isotope of ferromanganese crusts from Takuyo Daigo Seamount, northwest Pacific Ocean	CORE
2012/3/22	NAGATAKE Hiroyuki	Resistivity structure of Mt. Mihara, Izu Oshima by the System ACTIVE	ERI
2012/3/22	NAKAMURA Atsunori	Quantitative determination of erosion rates in humid region using depth profiles of in situ-produced Be-10 and Al-26	AORI

2012/3/22	NISHIKAWA Yasuhiro	Designing a martian broadband seismometer system under surface wind environment.	ERI
2012/3/22	NISHIYAMA Ryuichi	Joint Inversion of Gravimetric and Muon Radiographic Data for Visualizing the Three-dimensional Density Structure of Mt.Showa-Shinzan Lava Dome	ERI
2012/3/22	NIHONMATSU Ryosuke	A study on causes of tropical cyclone generation linked with the easterly waves	AORI
2012/3/22	NOGUCHI Masahiko	Diffusion coefficient of CH4 in ice Ih and its implication for CH4 in Martian atmosphere	CORE
2012/3/22	NOGUCHI Rina	Unique characteristics of cones in Central Elysium Planitia, Mars -Inspection for martian recent magmatism-	ERI
2012/3/22	NOBUI Rei	A study on the fast climate response under global warming using MIROC climate model	AORI
2012/3/22	HASEGAWA Kei	Seismic Waveform Evidence for Existence of an Ultra-low Velocity Zone with Significant Amounts of Iron in the lowermost mantle beneath the central Pacific	CORE
2012/3/22	HINA Shoko	Dehydration and deformation processes of siliceous sediments in subduction zones	CORE
2012/3/22	HIRATA Naoyuki	Depositions and re-distributions of saturnian ring particles on small satellites	UMUS
2012/3/22	FUKUSHIMA Ayaka	An attempt to reconstruct oceanic pH and pCO2 based on boron isotopic ratio in shells of Cretaceous ammnonites and nautiloids	AORI
2012/3/22	FUJITA Satoshi	The effects of modified rate- and state-dependent friction law on seismic cycle and stress triggering	ERI
2012/3/22	FUJITA Wataru	The origin of variety in mid-size Saturnian satellites: SPH simulations of giant impacts	GSFS
2012/3/22	FURUUCHI Kaoru	Analyses on the relationship between the inferred bit force and skull morphology in carnivoran mammals	CORE
2012/3/22	HOSHINO Yosuke	Numerical investigation on the role of tidal flow in two-layer exchange through a strait	CORE
2012/3/22	HONMA Tatsuro	Development of the imaging optics in the EUV spectral range onboard a low-altitude orbiter	CORE
2012/3/22	MAEDA Takafumi	An analysis of tropical intraseasonal variations simulated by a climate model: Dependence on the cumulus convection scheme	AORI
2012/3/22	MAEHARA Yuki	Tilt motions during the 2011 eruption of Shinmoe-dake, Kirishima volcanoes	ERI
2012/3/22	MATSUI Hiroki	Study of HDO distribution in the Venus atmosphere	CORE
2012/3/22	MATSUI Yuki	Multi-wavelength Spectroscopic Observations and Magnetohydrodynamic Simulations of Solar coronal Jet	CORE
2012/3/22	MATSUOKA Hiroaki	Experimental studies of thermal convection in a porous medium for researching crust formation	ERI
2012/3/22	MATSUMOTO Naoya	Rock-atmosphere interaction on the surface of Venus	CORE
2012/3/22	MIYAZAKI Yusuke	Implantation and diffusion of solar wind rare gas to chondrite-like materials on the surface of an asteroid	GCRC
2012/3/22	YAMAZAKI Kana	Effects of aspartic acid on polymorphism of CaCO3 crystalized in the presence of Mg2+	GCRC
2012/3/22	YAMASHITA Fumihiro	Variability associated with meso-scale eddies in the formation of the North Pacific Subtropical Mode water	AORI
2012/3/22	YUN Sunhe	Source process analysis of the 1923 Kanto earthquake using 3-D Green's functions	ERI
2012/3/22	YOKOTA Sho	A numerical study on development of typhoons from the ITCZ breakdown	AORI
2012/3/22	YOSHIMURA Atsushi	A study on generation and development of twin tropical cyclones	AORI

2012/3/22	WAKABAYASHI Akira	Oxygen and hydrogen isotope study in Springpole gold prospect, northwestern Ontario, Canada ～ New exploration tool for disseminated gold mineralization	CORE
2012/3/22	WAKABAYASHI Daisuke	Anomalous behavior of cristobalite in helium under high pressure	CORE
2012/3/22	WAKAMATSU Shun	Atmospheric-oceanic mechanism that causes rapid climate warming in a millennial-scale climate change during the last glacial period	AORI
2012/3/22	WAKITA Miyuki	The effects of water amount on planetary climate	CORE
2012/3/22	OKATA Megumi	A study on radiation transfer solution regarding radiation budget calculation of discretized three dimensional cloud	AORI

Aff.: Affiliation, CORE: Core group, ERI: Earthquake Research Institute, AORI: Atmosphere and Ocean Research Institute, Institute, JAXA: Japan Aerospace Exploration Agency, GCRC: Geochemical Research Center, CSIS: Center for Spatial Information Science, GSFS: Graduate School of Frontier Sciences, RCAST: Research Center for Advanced Science and Technology, UMUS: The University Museum.

(3) Changes in the Number of Doctoral Dissertations Sorted by Groups



AOS: Atmospheric and Oceanic Science, SPS: Space and Planetary Science, EPS: Earth and Planetary System Science, SES: Solid Earth Science, GBS: Geosphere and Biosphere

(4) List of Doctoral Dissertations (FY 2011)

Date	Category	Name	Dissertation Title	Aff.
2011/10/24	Course Doctor	MAK Sum	Love Wave Excitation by an Accretionary Wedge	ERI
2012/1/23	Course Doctor	TANAKA Takaaki	Structure and Dynamics of the Lunar Ionized Exosphere	JAXA

2012/1/23	Course Doctor	MURAKAMI Osamu	A study of the seismic wave transfer functions around the rupture zone of the Mid Niigata prefecture Earthquake in 2004	ERI
2012/3/6	Dissertation Doctor	WADA Akiyoshi	A Study on Interactions between Tropical Cyclones and the Ocean	AORI
2012/3/6	Dissertation Doctor	SASAKI Hideharu	Generation mechanisms of seasonal and interannual variations in the Hawaiian Lee Countercurrent and a role of local air-sea interactions on the variations	AORI
2012/3/6	Dissertation Doctor	SANO Shin-ichi	Late Jurassic–Early Cretaceous rudist bivalves in the Pacific: their palaeobiogeographical and evolutionary implications	CORE
2012/3/6	Dissertation Doctor	KATAYAMA Tetsuya	Petrographic Study of Alkali-Aggregate Reactions in Concrete	CORE
2012/3/22	Course Doctor	HAMANO Keiko	Coupled Evolution of Planetary Atmospheres and Magma Oceans after Giant Impacts	CORE
2012/3/22	Course Doctor	OCHI Tadafumi	Temporal Change of Plate Coupling Distribution During Tokai Slow Slip Event Inferred from GPS and Leveling Data	ERI
2012/3/22	Course Doctor	KOYAMA Toru	Study of Venus atmosphere dynamics using cloud tracking technique	JAXA
2012/3/22	Course Doctor	YAGI Masahiro	Observational studies on turbulent mixing in the Bussol' Strait	AORI
2012/3/22	Course Doctor	IKEDA Masayuki	Astronomical cycle recorded in the rhythms of the Mesozoic bedded chert and its relation with the global silica cycle	CORE
2012/3/22	Course Doctor	OZAKI Kazumi	A Theoretical Study on Oceanic Redox State and Biogeochemical Dynamics	GSFS
2012/3/22	Course Doctor	KAZAHAYA Ryunosuke	Searching for a linkage between volcanic gas flux and geophysical phenomena using sulfur dioxide visualization technique	GCRC
2012/3/22	Course Doctor	KAWAMURA Taichi	New Development of Lunar Seismology from Re-analyses of Apollo Seismic Data	JAXA
2012/3/22	Course Doctor	SATO Tomohiko	The lowermost Cambrian stratigraphy in the Chengjiang area, South China:The small shelly fossils diversification and relevant environmental changes	GSAS
2012/3/22	Course Doctor	SATO Yosuke	A numerical study on the microphysical properties of warm clouds off the west coast of California	AORI
2012/3/22	Course Doctor	TAKIGAWA Aki	Formation and evolution of circumstellar alumina: from evolved stars to the early solar system	CORE
2012/3/22	Course Doctor	TAKEMURA Shunsuke	Study of high-frequency seismic wave propagation in heterogeneous structure inferred from dense array observations and numerical simulations	ERI
2012/3/22	Course Doctor	TASAKA Miki	Grain-size sensitive creep of forsterite + enstatite aggregates	ERI
2012/3/22	Course Doctor	TOYOTA Takenori	Thermal Inertia of Fine Particle Layer: Implications to the Physical Structure of Martian Surface	ERI
2012/3/22	Course Doctor	FUJIYA Wataru	Formation and evolution of hydrous asteroids: constraints from Mn-Cr dating and stable isotopes of meteoritic carbonates	CORE
2012/3/22	Course Doctor	MORIOKA Yushi	Generation and decay mechanisms of subtropical dipole modes influencing the southern African climate	CORE
2012/3/22	Course Doctor	MORISHIGE Manabu	Estimate of seismic anisotropy around subduction zone based on numerical simulations of mantle convection	ERI

Aff.: Affiliation, CORE: Core group, ERI: Earthquake Research Institute, AORI: Atmosphere and

Ocean Research Institute, Institute, JAXA: Japan Aerospace Exploration Agency, GCRC: Geochemical Research Center, GSFS: Graduate School of Frontier Sciences, GSAS: Graduate School of Arts and Sciences

4. Performances of the Graduate Students

(1) The Number of Presentations at Scientific Conferences (2006-2011)

(Domestic) **1,544**
(International) **541**

(2) The Number of Published Papers (2006-2011)

(First-Authored, Refereed) **506**
(First-Authored, Non-refereed) **122**

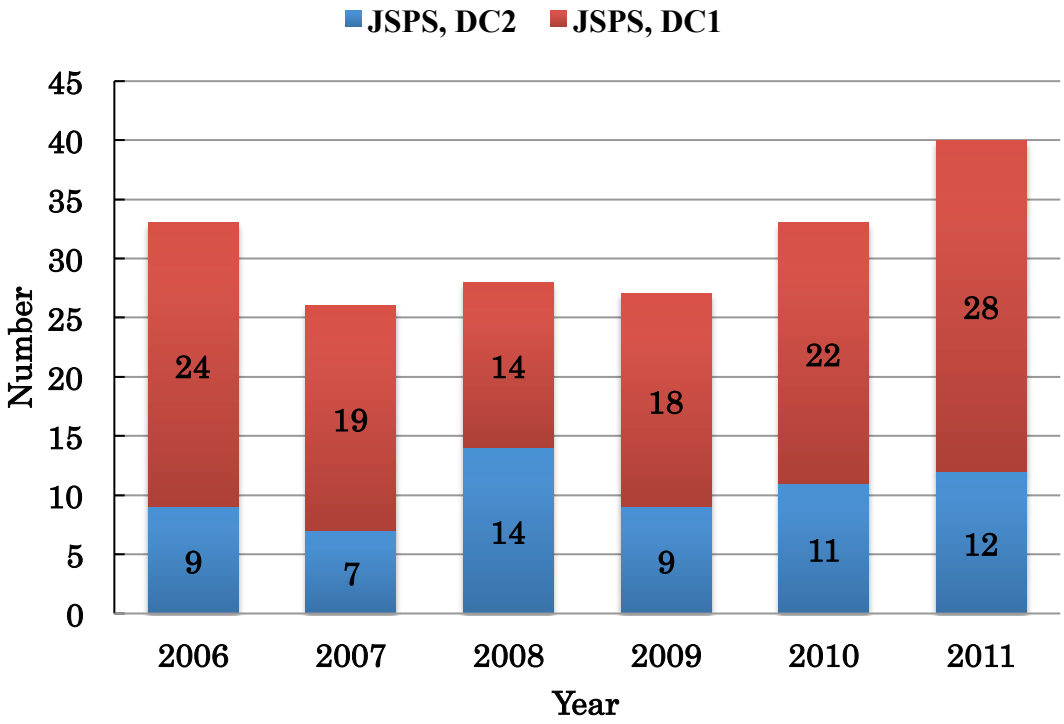
(3) Awards (2006-2011)

Many of the oral and poster presentations and first-authored papers submitted by master's and doctoral students in the department have won prizes. Below is a list of prizes awarded to the students from 2006 to 2011. For poster awards, please refer to each faculty member's individual documents.

Name	Awards and Prizes received by Students
Tajikara, M.	Award for Academic Papers, Japan Association for Quaternary Research, 2006/8
Kameda, S.	Auroral Medal, SGEPSS, 2006/11
Seike, K.	Best oral presentation award, Sedimentological Society of Japan, 2007/3
Kashiyama, Y.	Graduate-School-of-Science Award for outstanding students (Doctor Course), University of Tokyo, 2008/3
Murakami, G.	Auroral Medal, SGEPSS, 2007/9
Kawabata, I.	Student Awards, American Geophysical Union, 2007/12
Murakami, G.	Graduate-School-of-Science Award for outstanding students (Master Course), University of Tokyo, 2008/3
Iba, Y.	Graduate-School-of-Science Award for outstanding students (Master Course), University of Tokyo, 2008/3
Sasaki, T.	Graduate-School-of-Science Award for outstanding students (Doctor Course), University of Tokyo, 2008/3
Fujiwara, S.	Graduate-School-of-Science Award for outstanding students (Doctor Course), University of Tokyo, 2008/3
Hirasawa, T.	SSJ Best Talk Award, Sedimentological Society of Japan, 2008/4
Shiino, Y.	Best paper award, Palaeontological Society of Japan, 2008/6
Hirasawa, T.	Colbert Award, Society of Vertebrate Paleontology 2008/10
Hasegawa, K.	Outstanding Student Paper Award, American Geophysical Union (AGU), 2008/12
Kinoshita, T.	Outstanding student award, Society of Geomagnetism and Earth, Planetary and Space Sciences, 2008
Iba, Y.	Inoue Research Award for Young Scientists, 2009/1
Uchide, T.	Graduate-School-of-Science Award for outstanding students (Doctor Course), University of Tokyo, 2009/3
Ohta, K.	Graduate-School-of-Science Award for outstanding students (Master Course), University of Tokyo, 2009/3
Takigawa, A.	Graduate-School-of-Science Award for outstanding students (Master Course), University of Tokyo, 2009/3

Takigawa, A.	Student award by the Planetary Science Society, 2009/9
Fujiya, W.	Best Oral Presentation Award, Mass Spectrometry Society of Japan, 2009/9
Ikeda, M.	The Best Student Poster Award, Micropalaeontological Society, 2009/9
Odashima, Y.	Journal of Mineralogical and Petrological Science, Best Paper Award, 2009/9
Yamada, A.	Graduate-School-of-Science Award for outstanding students (Master Course), University of Tokyo, 2010/3
Fujimura, D.	Graduate-School-of-Science Award for outstanding students (Master Course), University of Tokyo, 2010/3
Yoshioka, K.	Graduate-School-of-Science Award for outstanding students (Doctor Course), University of Tokyo, 2010/3
Hirasawa, T.	Graduate-School-of-Science Award for outstanding students (Doctor Course), University of Tokyo, 2010/3
Shino, Y.	The Award of the Alwyn Williams Fund, The 6th International Brachiopod Congress, 2010/2
Monkawa, A.	Applied Mineralogy Award, Japan Association of Mineralogical Sciences, 2010/9
Ikeda, M.	Awards of Geological Society of Japan, 2010/9
Shirahama, Y.	Award for Excellent Presentations, Seismological Society of Japan, 2010/10
Tomita, T.	SVP Colbert Award, 2010/10/19
Yoshioka, K.	COSPAR Outstanding Paper Award for Young Scientists, 2010
Hirai, M.	Auroral Medal, SGEPSS, 2010
Hotta, H.	Graduate-School-of-Science Award for outstanding students (Doctor Course), University of Tokyo, 2011/3
Toriumu, S.	Graduate-School-of-Science Award for outstanding students (Doctor Course), University of Tokyo, 2011/3
Tomita, T.	Graduate-School-of-Science Award for outstanding students (Doctor Course), University of Tokyo, 2011/3
Murakami, G.	Graduate-School-of-Science Award for outstanding students (Doctor Course), University of Tokyo, 2011/3
Murakami, G.	President Prize, University of Tokyo, 2011/3
Hamada, Y.	Student Outstanding Presentation Award, Japan Geoscience Union, 2011/5
Fujiya, W.	Best Presentation Award, Japanese Society for Planetary Science, 2011/10
Zenitani, S.	Obayashi Award, Society of Geomagnetism and Earth, Planetary and Space Science of Japan, 2011
Shirakawa, K.	Auroral Medal, SGEPSS, 2011
Kinoshita, T.	Paper Award, Journal of Meteological Society of Japan, 2011
Kawai, K.	Award for Young Researcher, Seismological Society of Japan, 2011
Fujiya, W.	Graduate-School-of-Science Award for outstanding students (Master Course), University of Tokyo, 2012/3
Izumi, K.	Graduate-School-of-Science Award for outstanding students (Master Course), University of Tokyo, 2012/3
Takigawa, A.	Graduate-School-of-Science Award for outstanding students (Doctor Course), University of Tokyo, 2012/3
Takigawa, A.	Ikushi Prize, JSPS, 2012/3
Takigawa, A.	Special Post-Doc fellow (SPD), JSPS, 2012/4

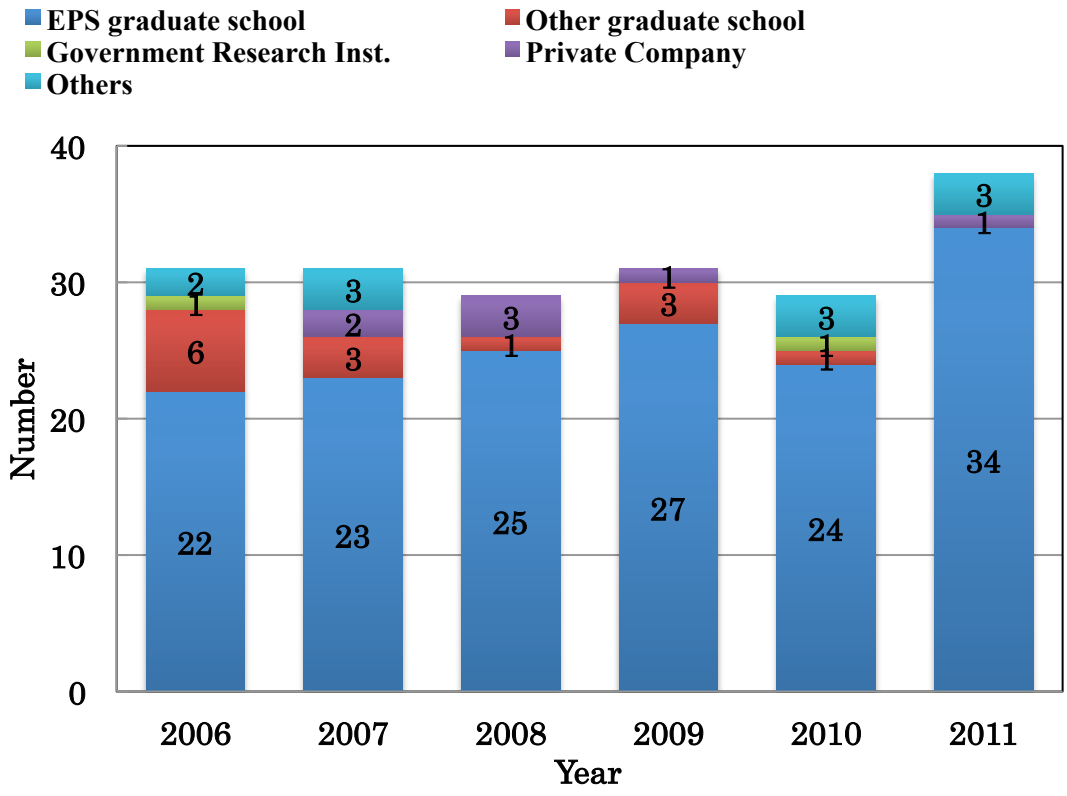
(4) JSPS Fellowships (DC1, DC2)　(206-2011)



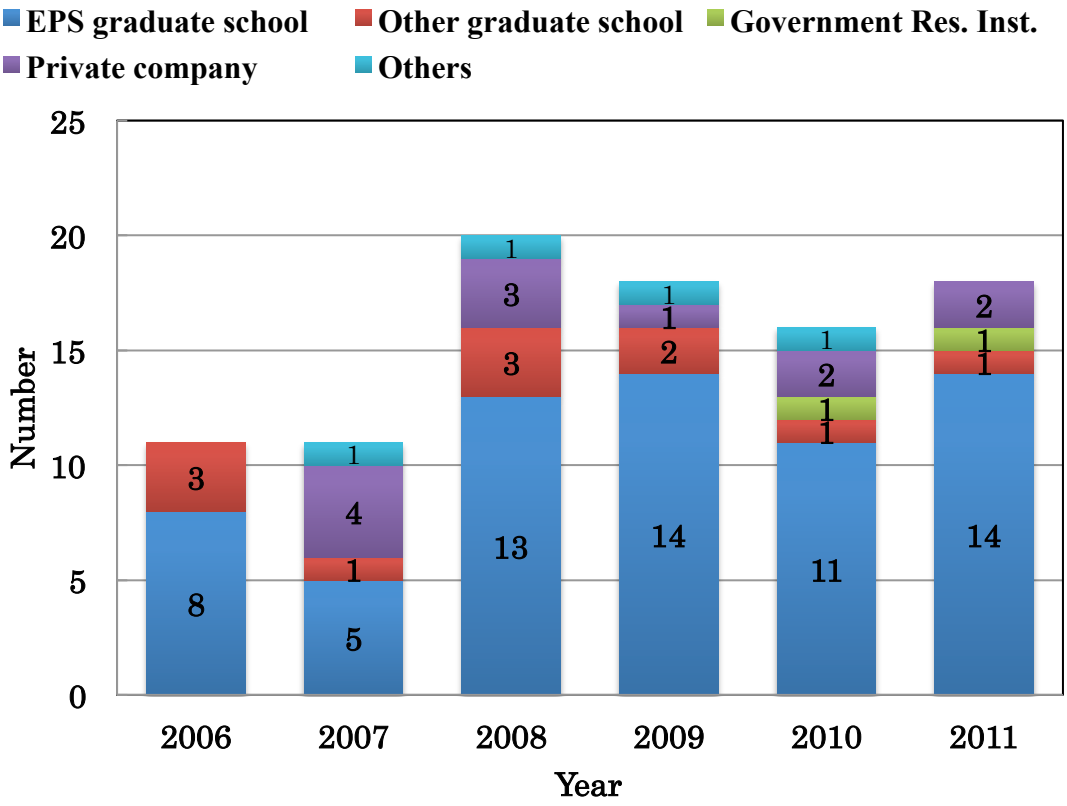
5. Career / Educational Path after Graduation

(1) Career / Educational Path of Undergraduate Students

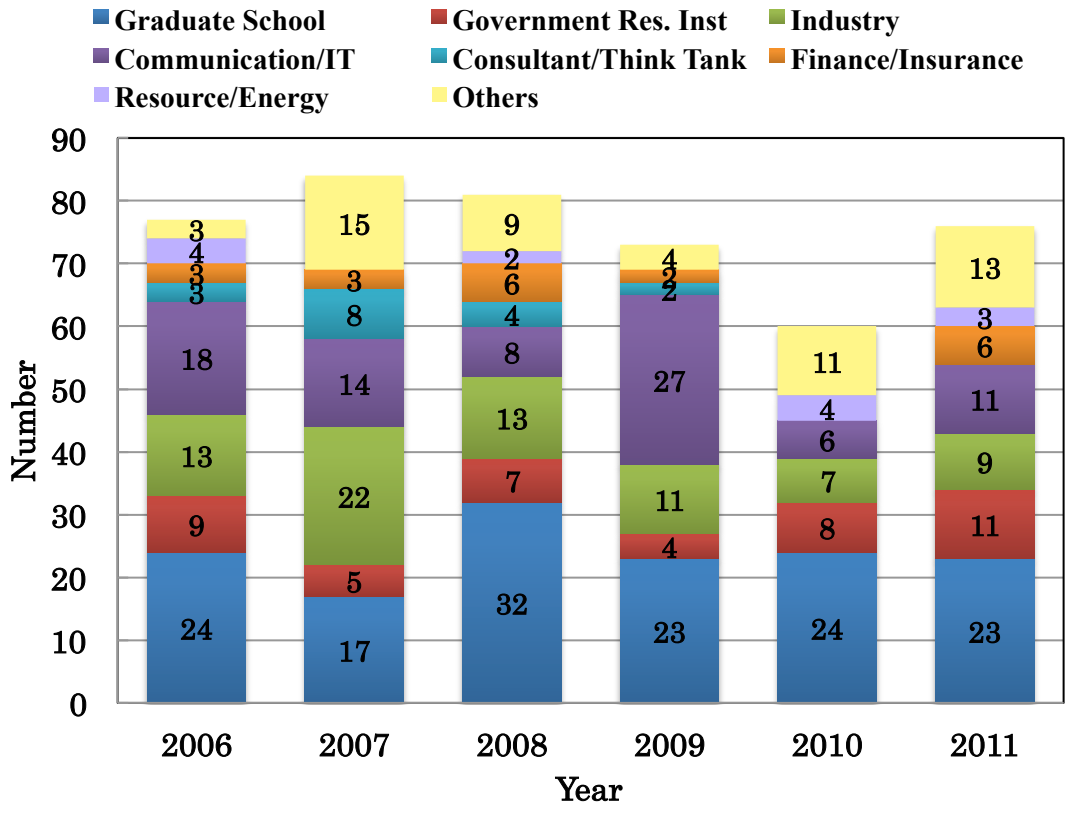
< Earth and Planetary Physics Program >



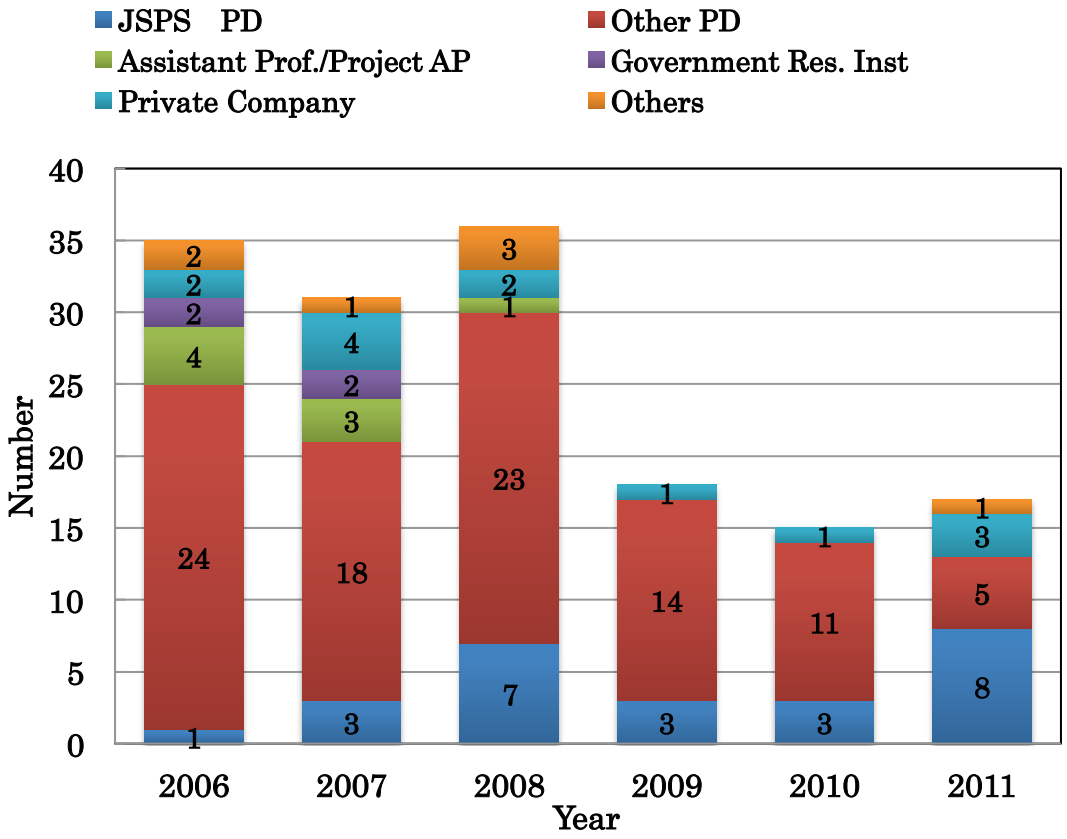
< Earth and Planetary Environmental Science Program >



(2) Career / Educational Path of Master's Students



(3) Career / Educational Path of Doctoral Students



6. Evaluation on Undergraduate Courses by Students

In the Graduate School of Science/Faculty of Science, evaluation is made by students on courses (classes, experiments, exercises and practices) provided in the undergraduate programs. Questionnaire items for classes are as follows. (Similar items are prepared for experiments, exercises and practices.)

[1] Degree of difficulty of the class
[2] Degree of progression of the class
[3] Teaching techniques (clearness of descriptions and writings on blackboard) of the teacher
[4] Enthusiasm of the teacher for giving lecture
[5] Student's interest in the subject after taking the class
[6] Opinion on omnibus (4 or 5 lecturers teaching in turns) classes
[7] Overall evaluation
[8] Student's attendance rate
[9] Student's efforts in the class
[10] Free opinion

Since the amount of questionnaire results for the past six years is enormous, only the overall evaluation is shown below. Results on the assessments on courses for the past two years are available by visiting the following website.

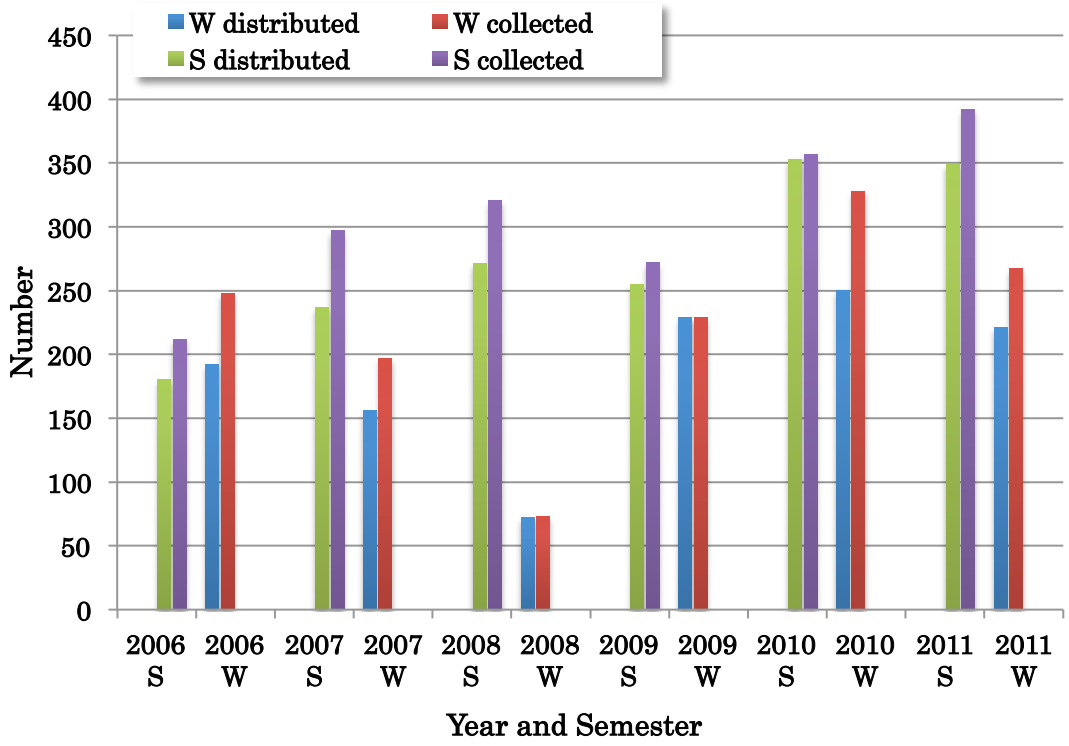
https://www.s.u-tokyo.ac.jp/gai/jugyou-hyouka/2012-summer/

Currently, there is no evaluation system by students for the graduate courses, which will be implemented in near future.

(1) Number of Distributed and Collected Questionnaires

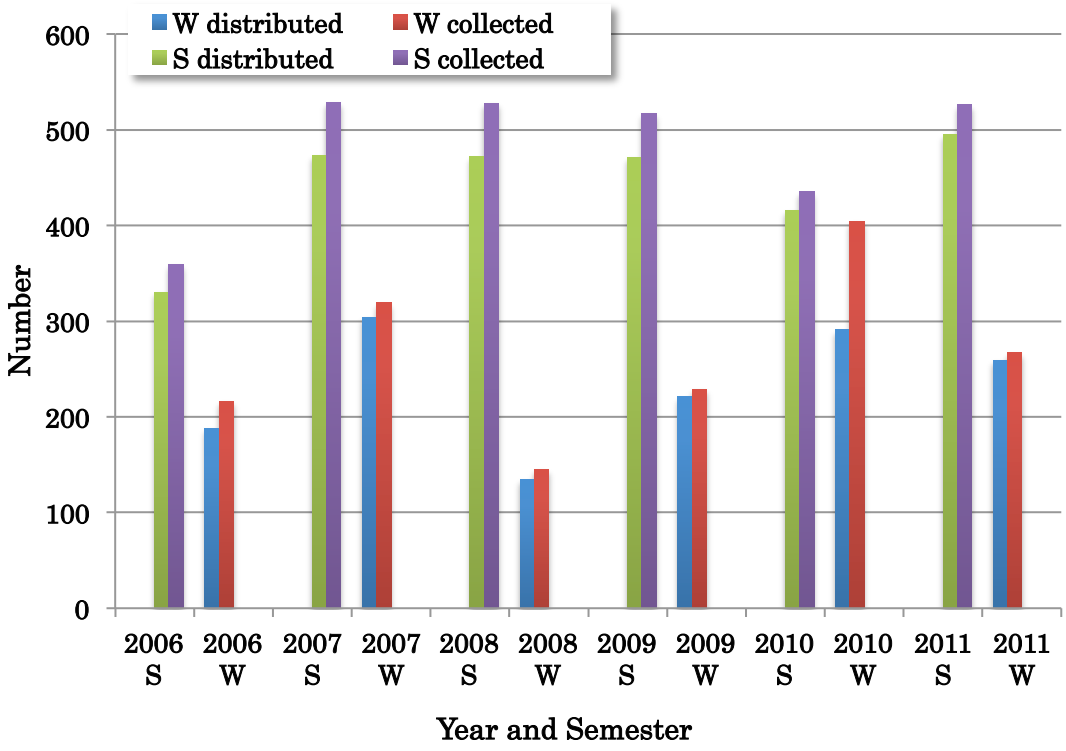
< Earth and Planetary Physics Program >

S: summer semester, W: winter semester



< Earth and Planetary Environmental Science Program >

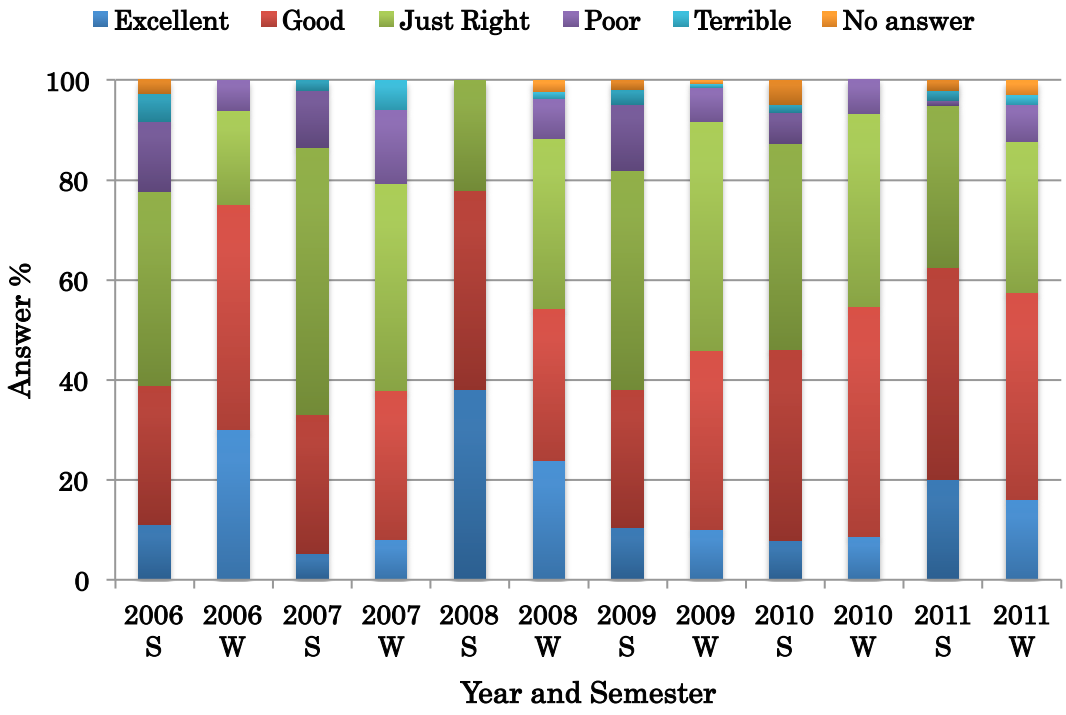
S: summer semester, W: winter semester



(2) Overall Evaluation

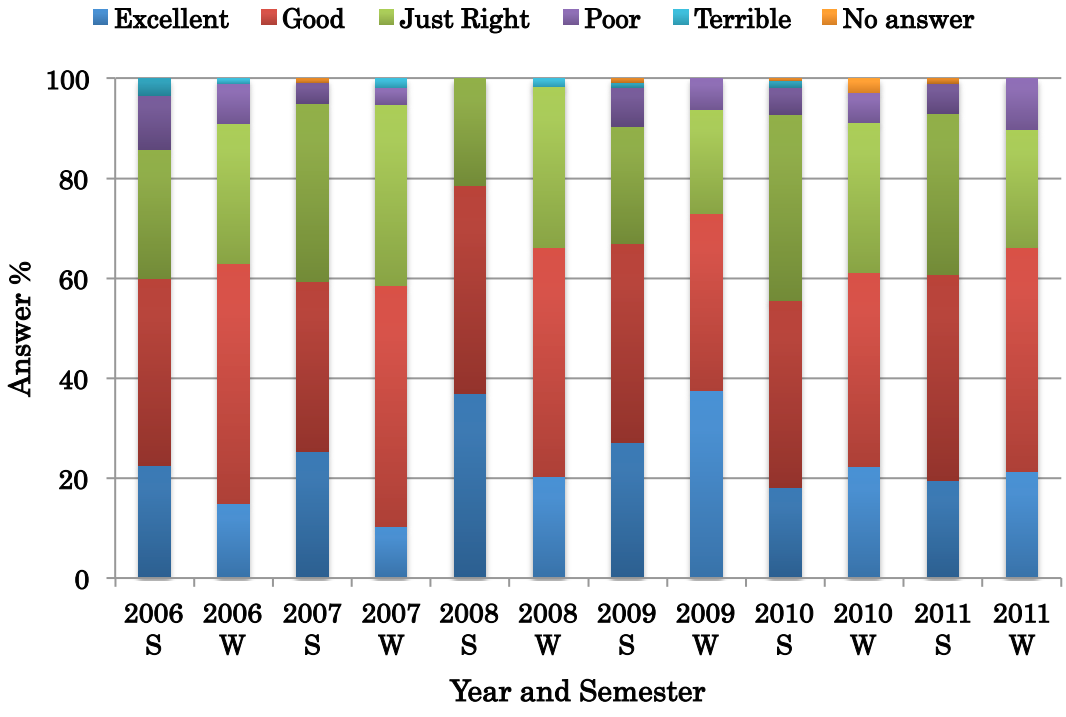
< **Third-Year Students in Earth and Planetary Physics Program** >

S: summer semester, W: winter semester



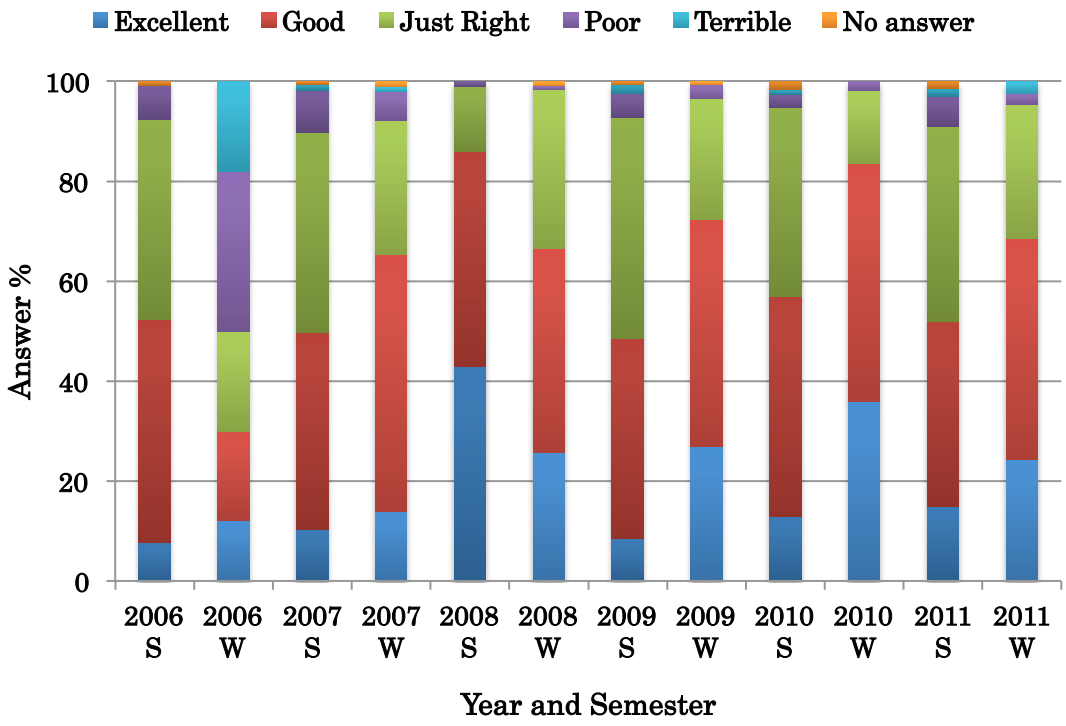
< **Fourth-Year Students in Earth and Planetary Physics Program** >

S: summer semester, W: winter semester



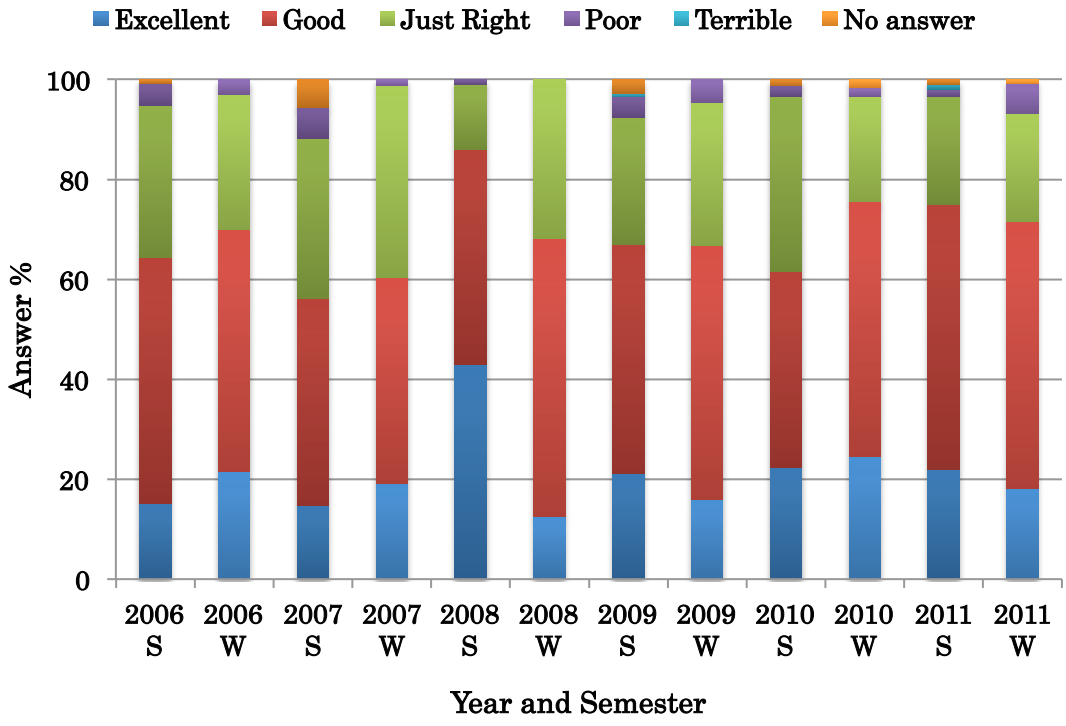
< **Third-Year Students in Earth and Planetary Environmental Science Program** >

S: summer semester, W: winter semester



< **Fourth-Year Students in Earth and Planetary Environmental Science Program** >

S: summer semester, W: winter semester



7. Questionnaire Results from Guardians

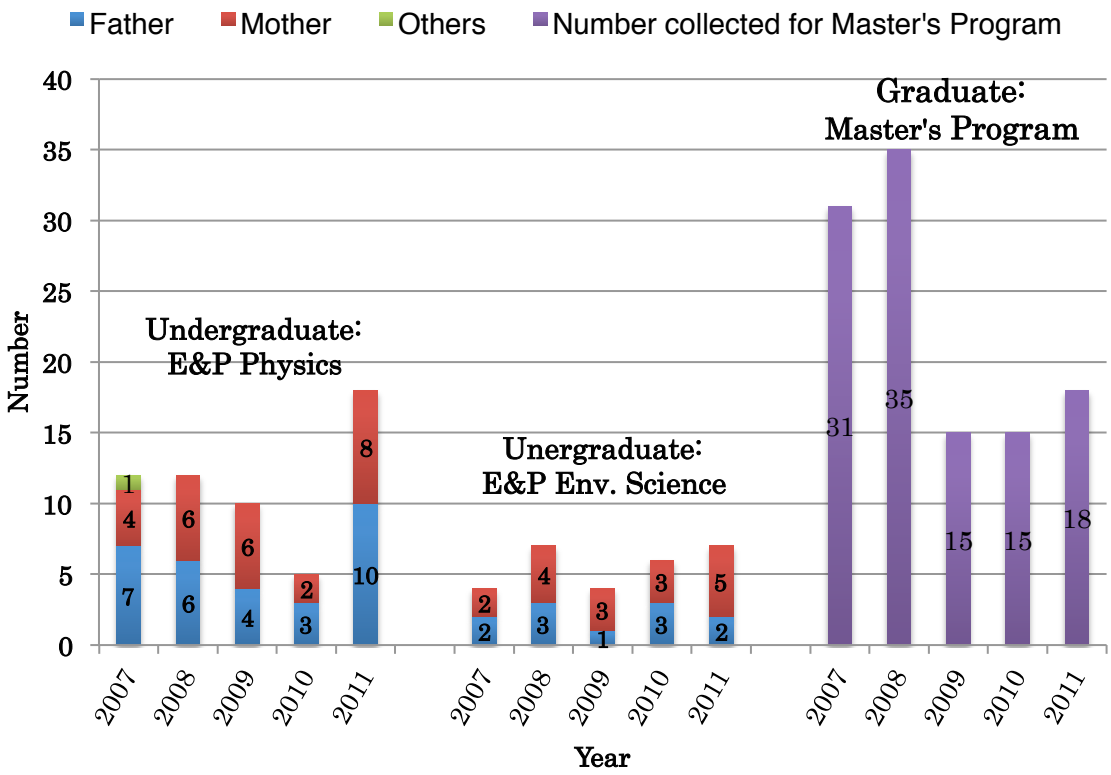
The Graduate School of Science sends questionnaires to parents (guardians) of the undergraduate students and master' s students who are graduating in March and asks their opinions such as their expectations before the students' enrollment and how they feel at present. Opinions can be stated freely, so there are many opinions received every year.
Contents of the questionnaire for undergraduate students are as follows.

1. What is your relationship with the student?
2. Please circle the Program in which the student enrolled.
3. What is your opinion on academic progress of the student?
4. Do you think the student has received thorough education in the undergraduate program (last half year at Komaba and two years at Hongo?)
5. Please give your opinion on the student's school life.
    A. What do you think of studies?
    B. What do you think of extracurricular activities?
6. Please give your opinion on the student's career/educational path.
    A. Please circle his/her career/educational path.
    B. Do you think he/she is satisfied with career/educational path?
    C. Are you satisfied with his/her career/educational path?
7. Have you discussed school life and studies/researches with the student?
    A. What about school life?
    B. What about studies/researches?
    C. What about career/educational path?

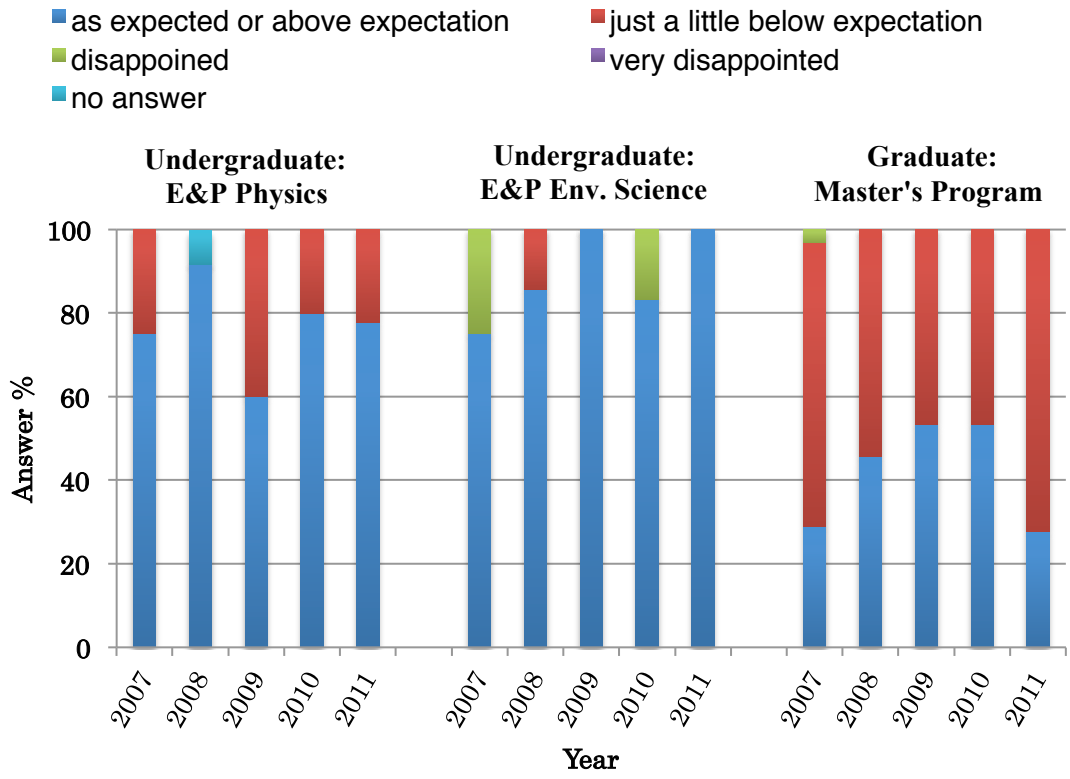
Questionnaire is almost the same for master's students, but the item 5 is not given and the item 4 is changed as follows:
4. Do you think the student has received thorough education and has been given enough opportunities for research in the Graduate School of Science?

Questionnaire results for the past five years are shown below.

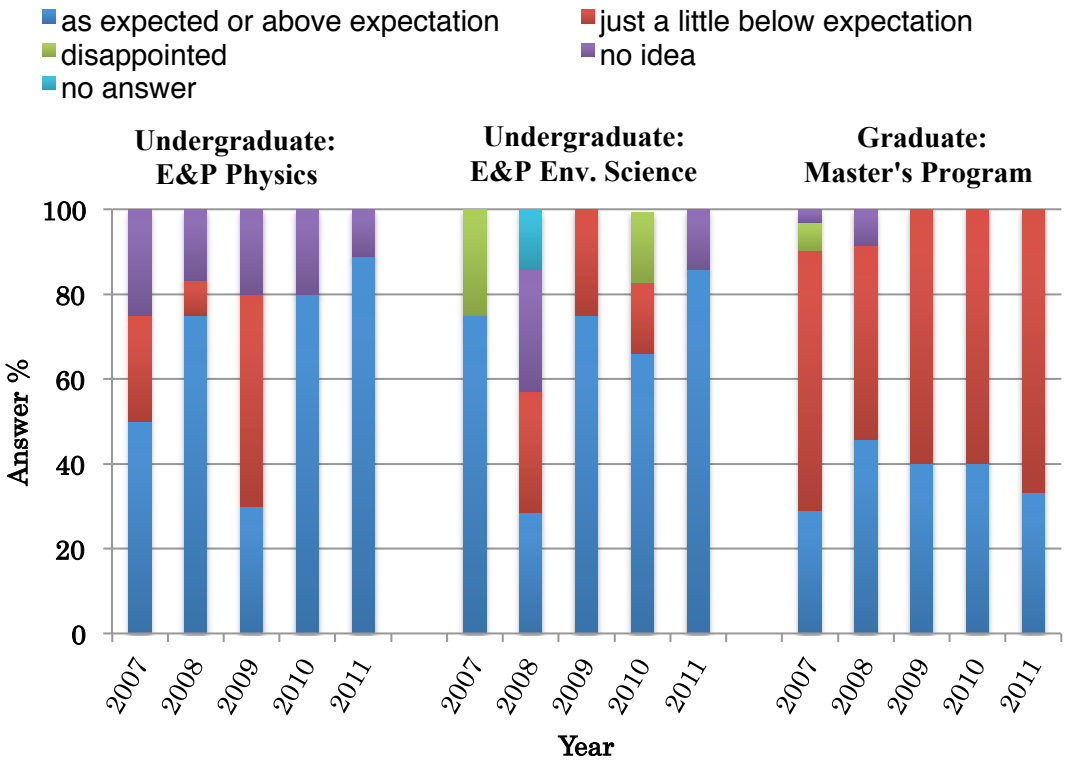
< **Respondents and Quantity of Responses** >



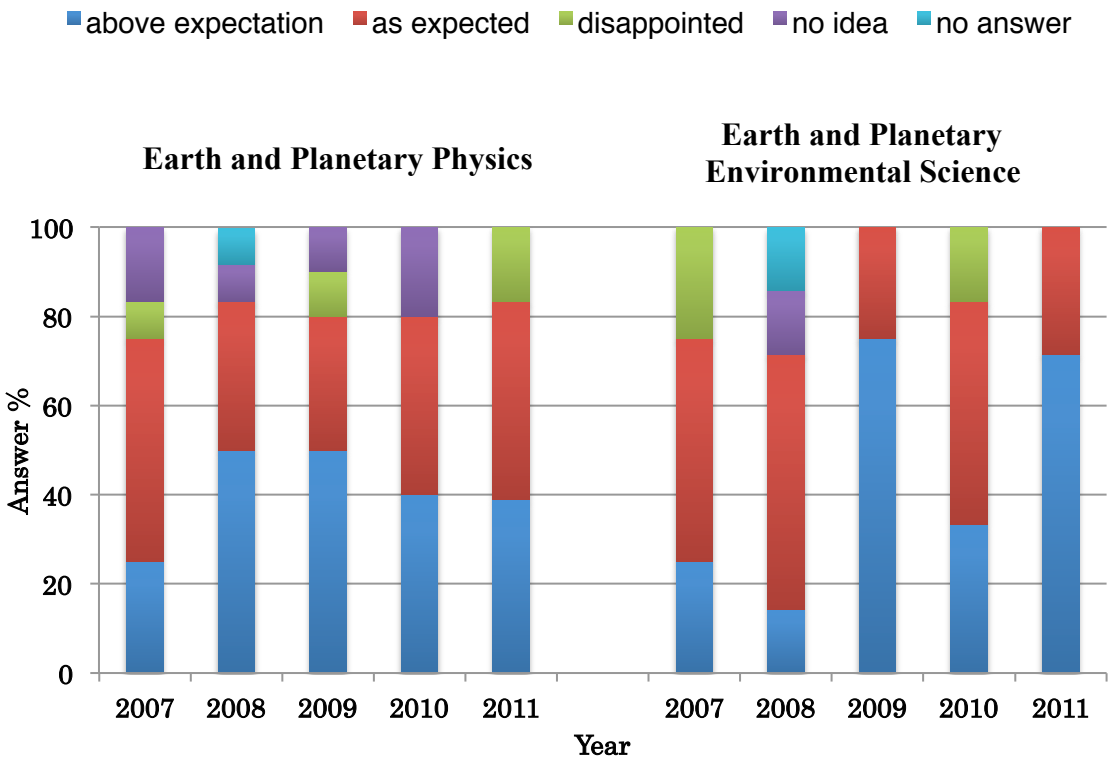
< **What is your opinion on academic progress of the student?** >



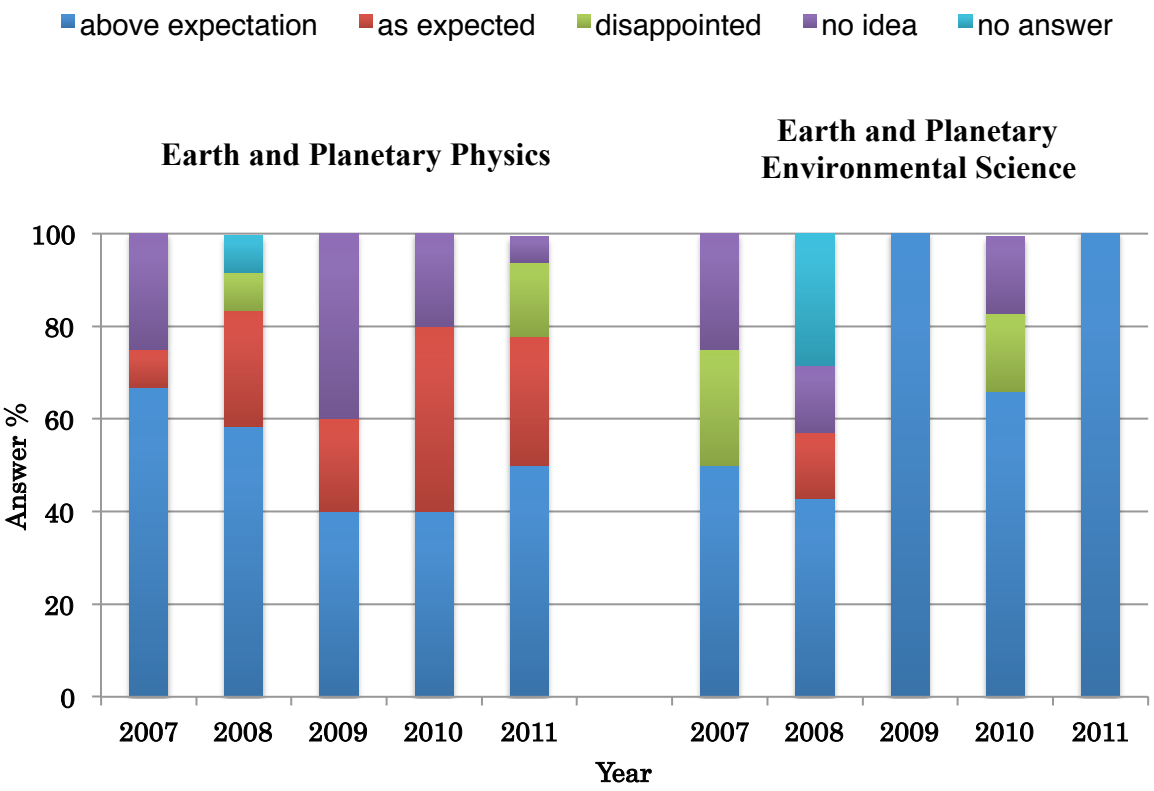
< Do you think the student has received thorough education in the undergraduate program? /Do you think the student has received thorough education in the Graduate School of Science? >



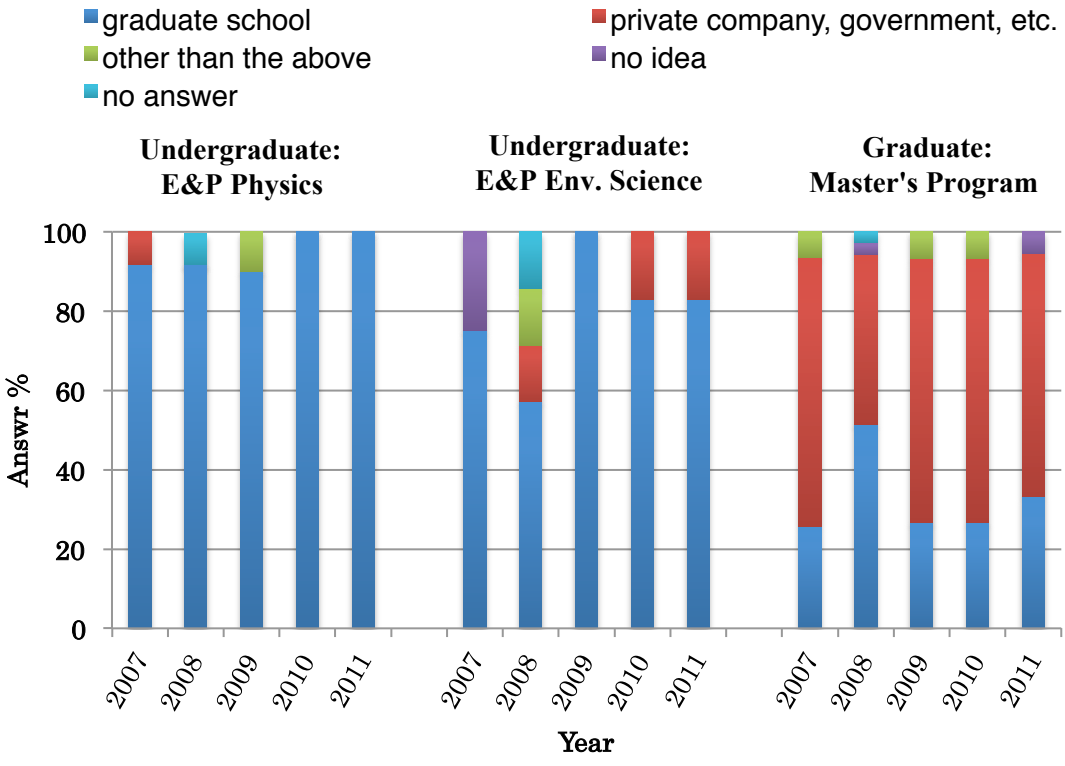
< Please give your opinion on the student's school life; What do you think of studies? >



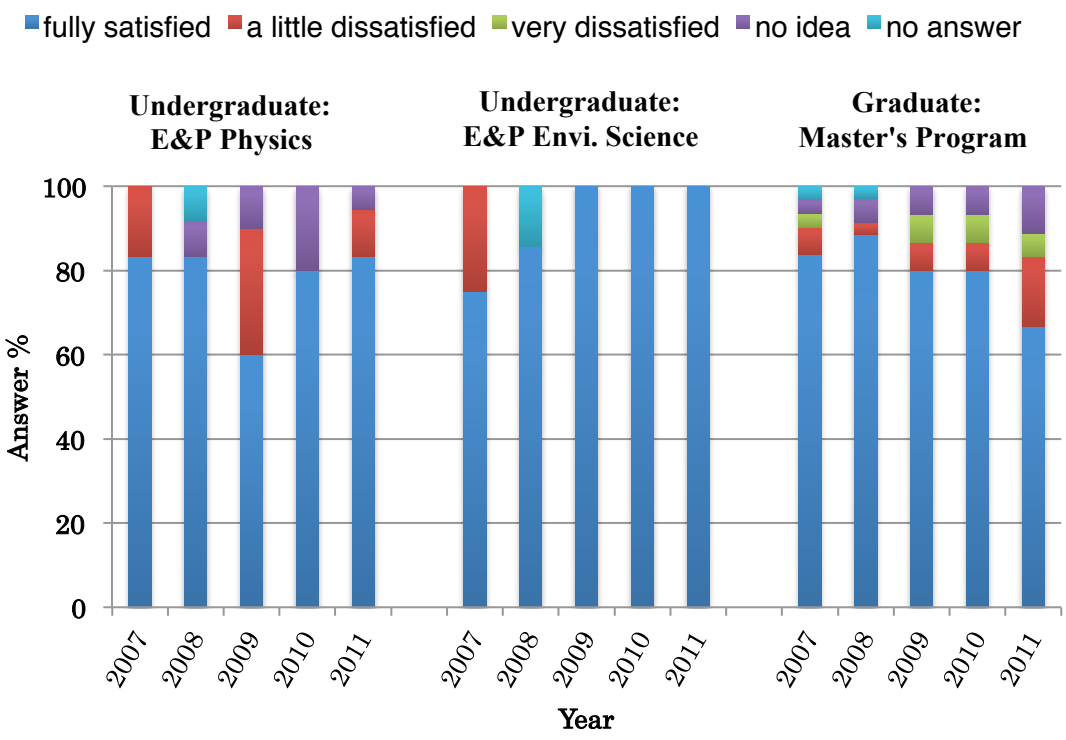
< Please give your opinion on the student's school life; What do you think of extracurricular activities? >



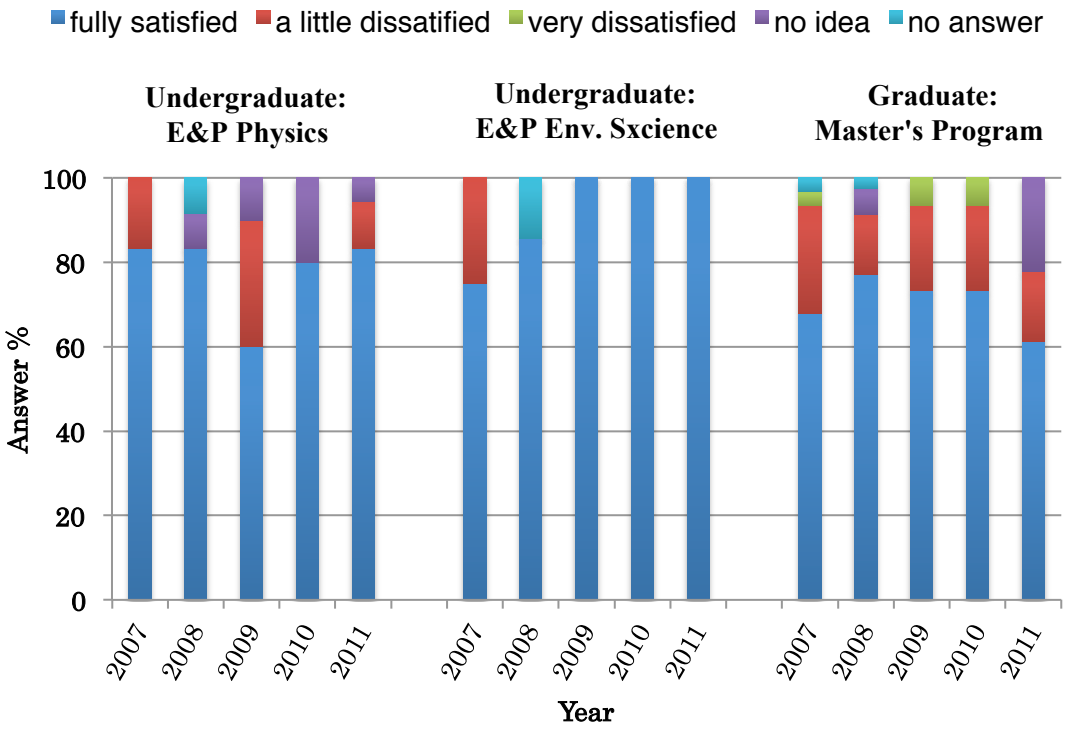
< Please give your opinion on the student's career/educational path; Please circle his/her career/educational path. >



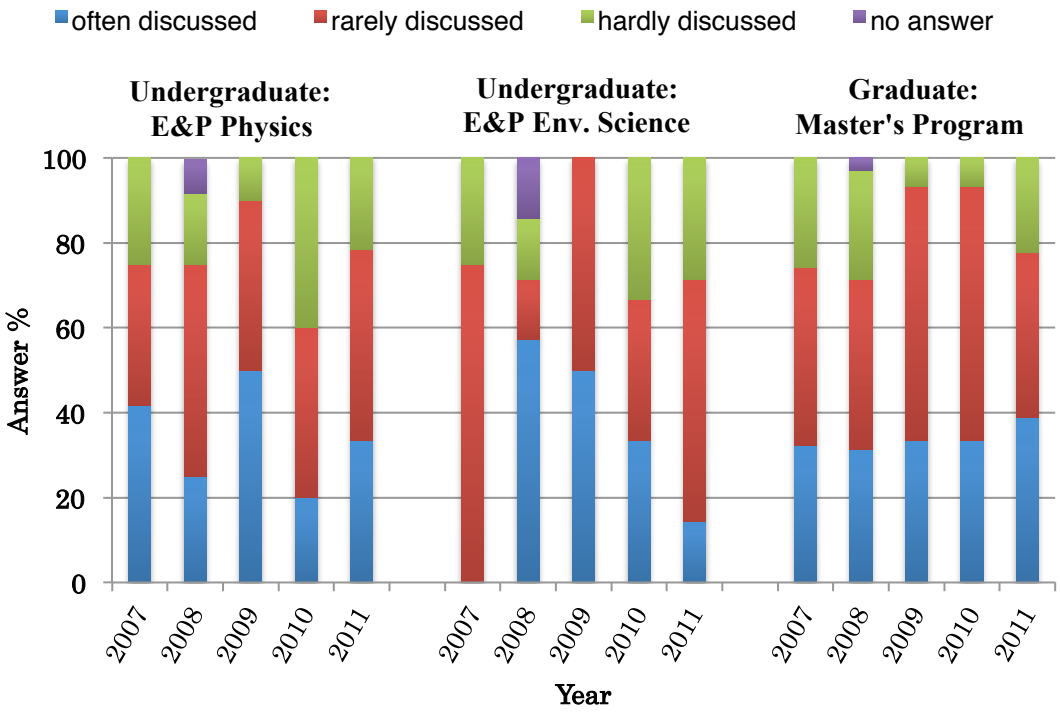
< Please give your opinion on the student's career/educational path; Do you think he/she is satisfied with career/educational path? >



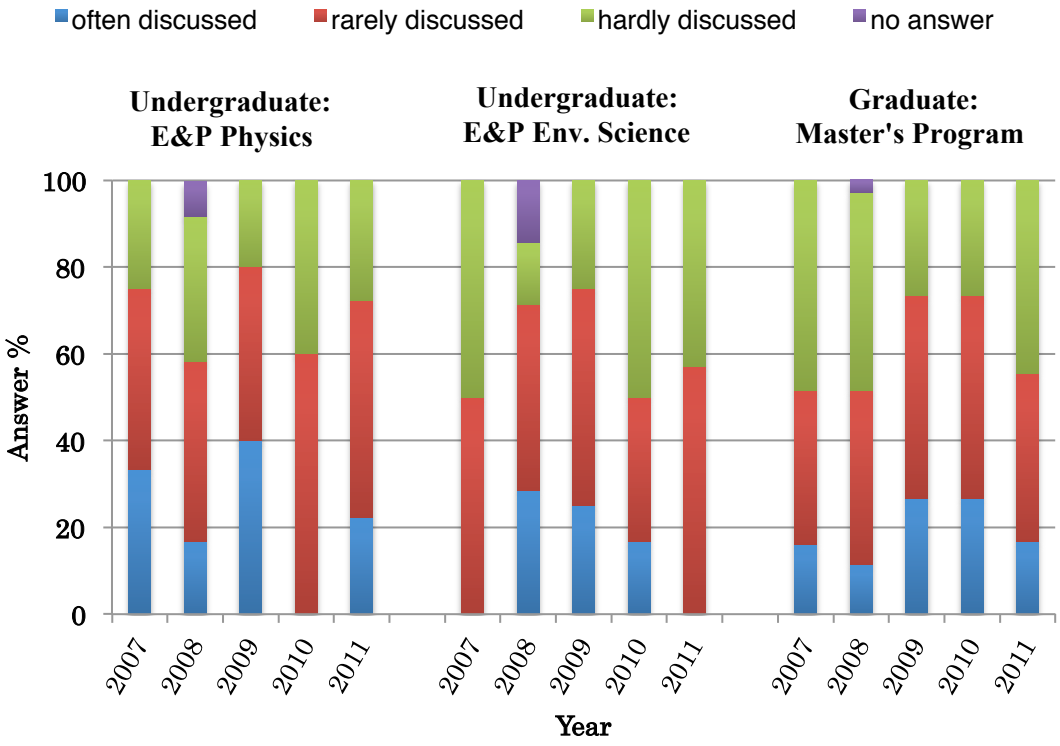
< Please give your opinion on the student's career/educational path; Are you satisfied with his/her career/educational path? >



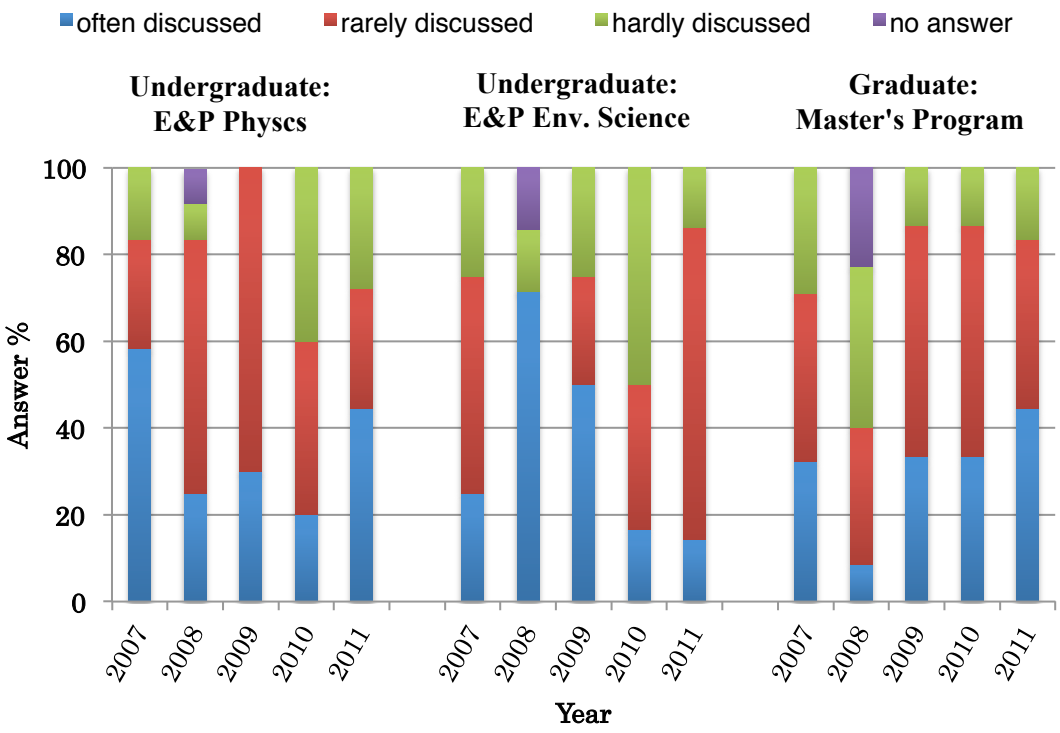
< Have you discussed school life and studies/researches with the student?; What about school life? >



< Have you discussed school life and studies/researches with the student?; What about studies/researches? >



< Have you discussed school life and studies/researches with the student?; What about career/educational path? >



IV. Research Achievement of Staffs

(1) Number of Scientific Papers Published (2006-2011)

(Refereed English papers)	**1,007**
(Non-refereed English papers)	**233**
(Refereed Japanese papers)	**68**
(Non-refereed Japanese papers)	**334**
(Internationally collaborated papers)	**473**

(2) Number of Conference Presentations (2006-2011)

(Invited presentations at international conferences)	**205**
(Presentations at international conferences)	**774**
(Invited presentations at domestic conferences)	**134**
(Presentations at domestic conferences)	**1,294**

(3) Patents (2006-2011)

(Domestic, Pub. No, Patent No.) 6

Name	Title	Patents
Takanobu Amano	Assist. Prof	Minoshima, T., Y. Matsumoto, T. Amano, and S. Masuda, method for numerically solving advection equation, method for numerically solving Vlasov equation and Maxwell equation, and program (Pub. No.:2011-159032)
Hajime Kayanne	Prof.	Application of Patent 2008-135204 (May 2008) Tokoro, T., T. Kato, K. Nozaki, K. Kato, A. Negishi and H. Kayanne, Neutralization of CO_2, AIST and Univ. Tokyo. (Domestic)
		Application of Patent 2009-178987 (July 2009) Tokoro, T., Y. Tanaka, T. Kato, K. Nozaki, K. Kato, A. Negishi and H. Kayanne, CO_2 Storage in Shallow Water Reservoir, AIST and Univ. Tokyo. (Domestic)
		Patent 4481938 (March 2010), Ide, Y. and H. Kayanne, Foraminifera Aquaculture System, Oceanic Planning Corp. and Univ. Tokyo. (Domestic)
Hidemi Tanaka	Lecturer	1. Patent No. 4805680 “Monitoring apparatus for underground gas-water mixed fluids” 2011, August 11. (Domestic)
Ataru Sakuraba	Assoc. Prof.	2011-107916, Parallel computing system that performs spherical harmonic transform, and control method and control program for parallel computing system, as an inventor.

(4) Cooperative Research, Research Contracts, and Grants/Gifts (Number, Amount)

(Cooperative Research)	14	JPY **190,258,000**
(Research Contracts)	19	JPY **787,906,000**
(Grants and Gifts)	18	JPY **33,792,000**

(5) Distinguished Achievements

Below is a list of awards for the past six years and highly cited papers published in the past six years. For more details and a list of awards and highly cited papers before FY 2006, please refer to

each faculty member's individual documents.

Name	Title	Awards and Honors
Kaoru Sato	Prof.	JMSJ Award, Meteorological Society of Japan, November 2010
Toshiyuki Hibiya	Prof.	Society Prize, Oceanographic Society of Japan, April 2008
		Distinguished Lecturer for the Ocean Sciences Section, Asia Oceania Geosciences Society (AOGS), August 2011
		Outstanding-Publication Award, Japanese-French Oceanographic Society, April 2010
Tomoki Tozuka	Assic. Prof.	Okada Memorial Prize, Oceanographic Society of Japan, April 2006
Hiroaki Miura	Assic. Prof.	Yamamoto-Syono Award for Outstanding Papers, Meteorological Society of Japan, November 2008
Toshio Yamagata	Emeritus Prof.	Fellow, American Geophysical Union, January 2007
		Techno-Ocean Award, April 2008
		Fellow, Japan Society of Fluid Mechanics, November 2011
		Ashok, K., S. K. Behera, S. A. Rao, H. Weng, and T. Yamagata, 2007 : El Niño Modoki and its possible teleconnection. J. Geophys. Res., 112, C11007, doi:10.1029/2006JC003798.【times cited: 225】
Naoji Sugiura	Prof.	Society Award, Geochemical Society of Japan, September 2012
Yutaka Kondo	Prof.	Fellow, American Geophysical Union, May 2009
		Medal with Purple Ribbon, MEXT, November 2012
		Miyake Award, Geochemical Society of Japan, December 2012
Ryuji Tada	Prof.	Japan Association for Quaternary Research Award, 2010
Masahiro Ikoma	Assic. Prof.	Award for Best Scientist, Japanese Society for Planetary Sciences, November 2008
		Young Scientists' Prize, MEXT, April 2012
Satoshi Takahashi	Assist. Prof.	Research Encouragement Award (Taguchi Award), Japanese Association of Organic Geochemists, August 2012
Kazuhito Ozawa	Prof.	Award for the Best Paper in 2008, Japanese Association of Mineralogical Sciences, September 2009
Gaku Kimura	Prof.	Society Award, Geological Society of Japan, September 2012
Yasutaka Ikeda	Assic. Prof.	Award for Academic Papers, Japan Association for Quaternary Research, August 2008
Satoshi Ide	Assic. Prof.	Young Scientists' Prize, MEXT, April 2006
		Ide, S., G. C. Beroza, D. R. Shelly and T. Uchide (2007), A scaling law for slow earthquakes, Nature, 447, 76-79, doi:10.1038/nature05780.【times cited: 120】
		Ide, S., A. Baltay, and G. C. Beroza (2011), Shallow dynamic overshoot and energetic deep rupture in the 2011 Mw 9.0 Tohoku-Oki earthquake, Science, 332, 1426-1429, doi:10.1126/science.1207020.【times cited: 72】
Tsuyoshi Iizuka	Lecturer	Japanese Young Geochemists of the Year, Geochemical Society of Japan, September 2009
		Excellent Paper Award, Japanese Geological Society, September 2008
Hidemi Tanaka	Lecturer	Outstanding research and education Prize, National Central University, Taiwan, June 2007

Atsuko Namiki	Assist. Prof.	Young Scientist Award, Japan Volcanology Society, May 2007
		Kobayashi, T., A. Namiki, and I. Sumita (2010), Excitation of airwaves caused by bubble bursting in a cylindrical conduit: Experiments and a model, *J. Geophys. Res.*, *115,* B10201, doi:10.1029/2009JB006828.【second Most Popular Journal Articles in AGU journal (Solid Earth) at the published week】
Tetsuro Urabe	Prof.	Best Article Award, Resource Geology Journal, March 2008
Kazuyoshi Endo	Prof.	Academic Award, Palaeontological Society of Japan, June 2006
Toshihiro Kogure	Assic. Prof.	Society Award, Mineralogical Society of Japan, September 2007
		CSSJ Award, Clay Science Society of Japan, September 2007
		Research Paper Award, Journal of Mineralogical and Petrological Sciences, Japan Association of Mineralogical Sciences, September 2010
		Jackson Mid-Career Clay Scientist Award, Clay Mineral Society (USA), June 2010
		Suzuki, M., K. Saruwatari, T. Kogure, Y. Yamamoto, T. Nishimura, T. Kato, and H. Nagasawa (2009), An acidic matrix protein, Pif, is a key macromolecule for nacre formation, Science, 325, 1388-1390.【times cited: 84】
Yohey Suzuki	Assic. Prof.	Young Investigator Award, Japan Association of Mineralogical Sciences, September 2010
Kazushige Tanabe	Emeritus Prof.	Society Award (Yokoyama Medal), Palaeontological Society of Japan, June 2010
		Fellow, Paleontological Society, October 2011

V. International Exchange Activities

1. Hosting Foreign Students and Researchers/Sending Students and Researchers Abroad

(1) Hosting

(Number of Foreign Students)	**35**
Undergraduate students	**3**
Master's Students	**12**
Doctoral Students	**20**
(Number of Foreign Researchers)	**37**

(2) Sending

(Number of Students)	**91**
Undergraduate Students	**3**
Master's Students	**28**
Doctoral Students	**60**
(Number of Researchers)	**49**

(3) Visitors from Abroad

(Number of Visitors from Overseas)	**371**

(4) The Overseas Internship Program for Outstanding Young Earth and Planetary Researchers (OIYR Program)

Through the OIYR Program launched in FY 2009, the department has sent 66 young researchers including graduate students, lecturers, assistant professors, postdoctoral fellows and researchers over the past three years to stay at the world's cutting-edge research institutions for a month or two and to have joint researches and discussions with the world's leading researchers. Strict screening standards have been established for selecting who should be sent, and the system has been designed so as to foster young researchers in the most effective way by sending them overseas. In fact, many of the young researchers supported by the program have returned becoming infinitely more aware of their responsibilities as researchers. The program therefore can be said to be very successful. Below is a list of internships and the amount paid, by fiscal year and expense item.

(List of Internships)

FY	Name	Position	Country	Research Institution	Days
2009	TACHIBANA, Shogo	Assistant Professor	USA	The University of Hawaii at Manoa	11
2010	MIYAJI, Tsuzumi	PD	Germany	Johannes Gutenberg-Universität Mainz	71
	OKUMURA, Taiga	Master's Student	USA	Arizona State University	47
	OKA, Eitaro	Lecturer	USA	The University of Hawaii at Manoa	37

	TORIUMI, Shin	Master's Student	USA	High Altitude Observatoy	59
	OKADA, Taku	Assistant Professor	Germany	Max Planck Insitute for Chemistry	34
	USHIE, Hiroyuki	Doctoral Student	USA	The University of Minnesota	64
	MORIOKA, Yushi	Doctoral Student	France	IPSL LOCEAN	64
	MIKOUCHI, Takashi	Assistant Professor	Germany	Ludwig-Maximilians-Universität München, Eberhard-Karls-Universität Tübingen	32
	HOTTA, Hideyuki	Master's Student	USA	High Altitude Observatoy	47
	SATO, Yosuke	Doctoral Student	USA	NCAR	45
	MORISHIGE, Manabu	Doctoral Student	USA	University of Michigan	43
	YOKOO, Naoki	Doctoral Student	Israel	Weizmann Institute of Science	32
	HONGO, Chuki	PD	France	Université de Provence	64
	TASAKA, Miki	Doctoral Student	USA	The University of Minnesota	59
	ISHIBASHI, Hidemi	PD	USA	The University of Hawaii at Manoa	62
	IKEDA, Masayuki	Doctoral Student	USA	Columbia University	61
	TONEGAWA, Takashi	PD	United Kingdom	University of Bristol	43
	MOCHIZUKI, Takashi	Doctoral Student	USA	University of Wisconsin-Milwaukee	55
2011	KAZAHAYA, Ryunosuke	Doctoral Student	Italy	Istituto Nazionale di Geofisica e Vulcanologia at Catania	62
	IRITANI, Ryosuke	Doctoral Student	France	Observatoire Midi-Pyrénées	76
	YANASE, Wataru	Assistant Professor	United Kingdom	University of Readins	42
	ITO, Junshi	PD	USA	University of Oklahoma	50
	KOMATSU, Kazuki	Lecturer	United Kingdom	The University of Edinburgh	79
	HIRANO, Shiro	Doctoral Student	USA	Harvard University	43
	IIZUKA, Tsuyoshi	Lecturer	Australia	The Australian National University	28
	IIZUKA, Tsuyoshi	Lecturer	United Kingdom	The University of Manchester	18
	TASAKA, Miki	Doctoral Student	USA	The University of Minnesota	37
	TSUCHIYA, Chikara	Doctoral Student	USA	NorthWest Research Associates, Inc.	43
	OKAMOTO, Kota	Doctoral Student	USA	NCAR	43
	SUGIMOTO, Megumi	PD	USA	Humboldt California State University	56
	TORIUMI, Shin	Doctoral Student	USA	Stanford Universtiy	39
	SHOJI, Daigo	Master's Student	Germany	Deutsches Zentrum für Luft- und Raumfahrt	73
	MUNEMOTO, Takashi	Doctoral Student	USA	Johns Hopkins University	51
	KINOSHITA,	Doctoral Student	USA	University of Wisconsin	30

	Takenari				
	HOTTA, Hideyuki	Doctoral Student	USA	High Altitude Observatoy	38
	SHIMIZU, Keisuke	Doctoral Student	United Kingdom	University of Exeter	93
	TAMURA, Shintaro	Doctoral Student	USA	San Diego State University	57
	MATSUI, Yuki	Master's Student	Belgium	Belgian Institute for Space Aeronomy	42
	TAKAGI, Seiko	Doctoral Student	Belgium	Belgian Institute for Space Aeronomy	79
	KOMA, Masashi	Doctoral Student	Australia	Australian Antarctic Division Australia	38
	ISHIBASHI, Hidemi	PD	USA	The University of Hawaii at Manoa	71
	IGARASHI, Mitsutsugu	Master's Student	USA	University of California, Santa Barbara	53
	YAMADA, Akinori	Doctoral Student	Canada	University of Toronto	55
	TAKAHASHI, Satoshi	Assistant Professor	New Zealand	GNS Science	65
	KUROKAWA, Aika	Master's Student	Switzerland	University of Geneva	68
2012	SETIAMARGA, Davin	PD	USA	Scripps Institution of Oceanography	41
	INOUE, Sayako	Master's Student	Denamarl	Technical University of Denmark	14
	INOUE, Sayako	Master's Student	France	University of Poitiers	18
	KONISHI, Kensuke	Doctoral Student	USA	University of California, Santa Barbara	62
	TAKEO, Akiko	Doctoral Student	USA	Brown University	61
	HOTTA, Hideyuki	Doctoral Student	Germany	Max-Planck-institut für Sonnensystemforschung	61
	TORIUMI, Shin	Doctoral Student	USA	Stanford Universtiy	36
	WATANABE , Michio	PD	USA	University of Washington	42
	OKUMURA, Taiga	Doctoral Student	USA	Arizona State University	61
	TANAKA, Yuki	Assistant Professor	USA	Woods Hole Oceanographic Institution	31
	URAKAWA, Shogo	PD	Australia	The Australian National University	42
	FUJII, Masakazu	Master's Student	France	Institut de Physique du Globe de Paris	44
	IIZUKA, Tsuyoshi	Lecturer	Australia	The Australian National University	38
	ITO, Junshi	PD	USA	NCAR, University of Oklahoma	46
	TSUCHIYA, Chikara	Doctoral Student	USA	NorthWest Research Associates, Inc.	31
	NISHIDA, Kozue	Doctoral Student	Spain	Universidad de Granada	40
	KATSURA, Shota	Master's Student	USA	The University of Hawaii at Manoa	31
	TSUIHIJI, Takanobu	Lecturer	USA	The Field Museum	34

	SHIMIZU, Keisuke	Doctoral Student	United Kingdom	University of Exeter	43
	NAMIKI, Atsuko	Assistant Professor	Chile, USA	El Tatio Geyser, University of California, Berkeley	23
	NISHIKAWA, Yasuhiro	Doctoral Student	France	Institut de Physique du Globe de Paris	55
	ASO, Naofumi	Doctoral Student	USA	Caltech	64

（Amount Paid） (Yen)

FY	Operating expenses				Administrative expenses	Total
	Young researchers** (2 months or over)	Young researchers (short stay)	Graduate students	Subtotal		
2009	0	183,060	0	183,060	0	183,060
2010	3,674,144	2,972,230	10,064,660	16,711,034	2,799,266	19,510,300
2011	3,588,588	4,331,797	18,499,175	26,419,560	1,798,104	28,217,664
2012*	563,800	4,024,490	8,527,960	13,116,250	914,827	14,031,077
Total	7,826,532	11,511,577	37,091,795	56,429,904	5,512,197	61,942,101

*Figures confirmed as of October 31for FY2012

**Young researchers: lecturers, assistant professors and PDs

(5) GCOE: Sending Graduate Students to International Conferences

Through the Global COE program, "from the Earth to 'Earths'" : Interdisciplinary study on habitable planets, collaborated with Tokyo Institute of Technology, the department sends about 8 to 16 doctoral students every year to international academic conferences and fosters young researchers with interdisciplinary perspective, international sense and ability to take action in science. Lists of students sent to international conferences are shown below.

（Number of Doctoral Students Sent to International Conferences）

	D1	D2	D3	D4	Total
FY2009	5	1	1	0	7
FY2010	4	11	1	0	16
FY2011	3	3	2	0	8
FY2012*	4	5	3	1	13
Total	16	20	7	1	44

* : Including oncoming conferences

（List of International Conferences）

FY	Name	Grade	International Conference		
			Name	Place	Days
2009	YAMANE, Masako	D2	First Antarctic Climate Evolution Symposium	Granada, Spain	5

	MAK Sum	D3	2009 AGU Fall Meeting	San Francisco, USA	5
	KONISHI, Kensuke	D1	2009 AGU Fall Meeting	San Francisco, USA	5
	KUSUDA, Chiho	D1	2009 AGU Fall Meeting	San Francisco, USA	5
	FUJIYA, Wataru	D1	2009 AGU Fall Meeting	San Francisco, USA	5
	MORIOKA, Yushi	D1	2010 Ocean Sciences Meeting	Portland, USA	5
	MORI, Ken	D1	2010 Ocean Sciences Meeting	Portland, USA	5
2010	KUBOTA, Yoshimi	D1	10th Internatl Conf. Paleoceanography	San Diego, USA	6
	IKEDA, Masayuki	D2	THE 8TH INTERNATIONAL CONGRESS ON THE JURASSIC SYSTEM	Sichuan, China	5
	TOYOTA, Takenori	D2	AOGS	Hyderabad, India	5
	MURAKAMI, Go	D2	EGU	Vienna, Austria	6
	TAKIGAWA, Aki	D2	AOGS	Hyderabad, India	5
	HIRAI, Mariko	D3	38th COSPAR	Bremen, Germany	8
	KAZAHAYA, Ryunosuke	D2	AGU2010 Fall	San Francisco, USA	5
	TASAKA, Miki	D2	AGU2010 Fall	San Francisco, USA	5
	KINOSHITA, Takenari	D2	AGU Chapman Conference on Atmospheric Gravity Waves and Their Effects on General Circulation and Climate	Honolulu, USA	5
	KITAGAWA, Naomasa	D1	Hinode-4: unsolved problems and recent insights	Palermo, Italy	5
	IIDA, Yusuke	D2	Hinode-4: unsolved problems and recent insights	Palermo, Italy	5
	YAMADA, Akinori	D1	Lunar and Planetary Science Conference	Woodlands, USA	5
	FUJIYA, Wataru	D2	Lunar and Planetary Science Conference	Woodlands, USA	5
	USHIE, Hiroyuki	D2	AGU2010 Fall	San Francisco, USA	5
	SATAKE, Wataru	D1	Lunar and Planetary Science Conference	Houston, USA	5
	TAKIGAWA, Aki	D2	Lunar and Planetary Science Conference	Houston, USA	5
2011	KITAGAWA, Naomasa	D2	The 5th Coronal Loops Workshop	Palma, Spain	4
	KUBOTA, Yoshimi	D2	INQUA	Bern, Switzerland	8
	SHIMIZU, Keisuke	D1	The 13th European Society for Evolutionary Biology Conference	Tuebingen, Germany	6
	YAMAGUCHI, Yasuhiko	D2	25th International Meeting on Organic Geochemistry	Interlaken, Switzerland	6
	HOSOUCHI, Mayu	D1	EPSC-DPS Joint Meeting 2011	Nantes, France	6

	IIDA, Yusuke	D3	Fifth Hinode Science Conference	Boston, USA	6
	TAKIGAWA, Aki	D3	The 43rd Lunar and Planetary Science Conference	Houston, USA	5
	SAKAI, Risa	D1	The 43rd Lunar and Planetary Science Conference	Houston, USA	5
2012	SHIMIZU, Keisuke	D2	First Joint Congress on Evolutionary Biology	Ottawa, Canada	6
	YAMAMOTO, Shoji	D4	12th International Coral Reef Symposium	Cairns, Australia	5
	INOUE, Shihori	D1	12th International Coral Reef Symposium	Cairns, Australia	5
	HIGASHIMORI, Katsuaki	D2	39th COSPAR (Committee on SPAce Research) Meeting	Mysore, India	9
	OGAWA, Fumiaki	D3	Dynamics and Predictability of High-impact Weather and Climate Events An ICDM Workshop 2012	Kunmin, China	4
	SATAKE, Wataru	D3	The 75th Annual Meetings of the Meteoritical Society	Cairns, Australia	6
	ASO, Naofumi	D1	AOGS - AGU (WPGM) Joint Assembly 2012	Singapore	5
	IZUMI, Kentaro	D1	The Third International Congress on Ichnology (ICHNIA 2012)	St. John's, Canada	5
	WATANABE, Yoshiyasu	D2	IAU XXVIII General Assembly	Beijing, China	5
	CHO, Yuichiro	D2	International Workshop on Instrumentation for Planetary Missions	Washington D.C., USA	3
	SARUYA, Tomotaka	D2	American Geophysical Union Fall Meeting	San Francisco, USA	5
	NAKAMURA, Atsunori	D1	American Geophysical Union Fall Meeting	San Francisco, USA	5
	SATAKE, Wataru	D3	44th Lunar and Planetary Science Conference	Houston, USA	5

2. Contribution to International Community

Faculty members in the department play various roles in international conferences. Below is a list of contributions as editorial committee members of international journals, board members of international conferences and organizing committee members of international conferences. For contributions to domestic conferences and as session conveners of domestic and international conferences, please refer to each faculty member's individual documents.

(1) Editorships for International Journals

Name	Title	Editorships for International Journals
Kaoru Sato	Prof.	Chief Editor (2008-2009), Co-Chief Editor (2010-2011) , Editor (2000-2002, 2004-2007) , Journal of the Meteorological Society of Japan
Toshiyuki Hibiya	Prof.	Editor-in-Chief, Journal of Oceanography (2011–Present)
Makoto Koike	Assoc. Prof.	Editor of SOLA (Scientific Online Letters on the Atmosphere), Japan Meteorological Society (2006-present)
Tomoki Tozuka	Assoc. Prof.	Associate Editor, Geophysical Research Letters (2009-2011)
		Editor, Journal of Oceanography (2011)

Toshio Yamagata	Emeritus Prof.	Associate Editor, Geophysical and Astrophysical Fluid Dynamics (Taylor & Francis)
		Editorial Board Member, Dynamics of Atmospheres and Oceans (Elsevier) Editorial Board Member, World Scientific Series on Meteorology of East Asia
		Member of Editorial Board, Climate Science and Policy (Euro-Mediterranean Center on Climate Change)
		Chief Editor, Ship & Ocean Newsletter, Ocean Policy Research Foudation
Masahiro Hoshino	Prof.	Associate Editor, Journal of Geophysical Research (2002-2006)
Takashi Mikouchi	Assoc. Prof.	Steering Committee Member, "Earth, Planets, and Space" (2007-present)
		Publications Committee Member, Meteoritical Society (2011-present)
		Associate Editor, Journal of Mineralogical and Petrological Sciences (2011-present)
Takaaki Yokoyama	Assoc. Prof.	Associate Editor, Publications of Astronomical Society of Japan (2005-2009)
Yutaka Kondo	Prof.	Editor, Journal of Atmospheric Chemistry (2007–2009)
		Steering committee member of SOLA (scientific journal) of Meteorological Society of Japan (2006–2012)
		Advisory board member, Journal of Earth Science of Taiwan (2005–2007)
Ryuji Tada	Prof.	Associate Editor, Paleoceanography (2008-present)
Hiroko Nagahara	Prof.	Associate Editor, Meteocitics and Planetary Science (1998-2007)
		Associate editor, Geocimica et Cosmochimica Acta (2006-present)
		Advisory board, Earth and Plaentary Science Letters (2011-present)
Kazuhito Ozawa	Prof.	Geochemistry, Geophysics, Geosystems, Associate editor (2006-2009)
Gaku Kimura	Prof.	Editorial Advisory Board member, Island Arc, 2011
Satoshi Ide	Assoc. Prof.	Associate Editor, Journal of Geophysical Research (2010-present)
Tetsuro Urabe	Prof.	Associate Editor, Resource Geology Journal
Kazuyoshi Endo	Prof.	Editor and Vice-Editor, Paleontological Research
Takashi Murakami	Prof.	Editor in Chief, Journal of Mineralogical and Petrological Sciences
		Advisory Board member, Elements
Toshihiro Kogure	Assoc. Prof.	Associate Editor, Clays and Clay Minerals (2007-2011)
		Editor, Japanese Magazine of Mineralogical and Petrological Sciences (2006-2011)
		Editor, Clay Science (2006-2011)
Kazushige Tanabe	Emeritus Prof.	Editorial Advisory Board, The Island Arc (2006–2008)
		Associate Editor, Paleontological Research (2006–2011)

(2) Board Members and Organizing Committee Members of International Societies and Conferences

Name	Title	President/Vice President/Committee Chair of International Societies and Conferences
Kaoru Sato	Prof.	Scientific Discipline Representative, Scientific Committee on Solar-Terrestrial Physics (2002–present)
		Convener, AGU Chapman Conference on Atmospheric Gravity Waves and Their Effects on General Circulation and Climate (2011)
Toshiyuki Hibiya	Prof.	Executive Committee Member, International Association for the Physical Sciences of the Oceans (IAPSO) (2011–present)
		President, Ocean Sciences Section of the Asia Oceania Geosciences Society (AOGS) (2011–present)
		Full Member, IAPSO/SCOR Working Group 121 on "Deep-Ocean Mixing" (2003–2008)
		Member, Science Advisory Committee for the International Pacific Research Center (IPRC) of the University of Hawaii, U.S.A. (2007-Present)
Toshio Yamagata	Emeritus Prof.	Chairperson, WCRP/CLIVAR Workshop on Western Tropical Pacific: Hatchery for ENSO and Global Teleconnections
		Organizer, International Symposium "Role of the Indo-Pacific Oceans in Climate Change and Variability in Commemoration on the 50th Anniversary of IOC/UNESCO"
		Organizer, SATREPS Symposium on Climate Prediction and Its Application in the Southern African Region
Masahiro Hoshino	Prof.	Convener, 2nd International Space Plasma Symposium (2011)
Takashi Mikouchi	Assoc. Prof.	Nomenclature Committee Member, Meteoritical Society (2010–present)
		Local Organizing Committee Member, 71st Annual Meeting of the Meteoritical Society (2008)
		Program Committee Member, 71st Annual Meeting of the Meteoritical Society (2008)
Takaaki Yokoyama	Assoc. Prof.	LOC Member, Conference of Space Weather Modelings (2006)
		LOC Member, Flux Emergence Workshop (2008)
		LOC Member, Plasma Conference 2011 (2011)
Yutaka Kondo	Prof.	Science Committee Member, GAW/WMO (2007–2010)
		Member, Atmospheric Brown Cloud (ABC)–Asia Science Team (UNEP) (2010–present)
		Collaborator, NCAR program funded by NSF "Chemistry and climate over Asia" (2011–present)
		Organizing Committee President, Fourth China-Korea-Japan Joint Conference on Meteorology (2009)
Ryuji Tada	Prof.	Science Steering Committee Member, Past Global Changes [PAGES] Project, International Geosphere Biosphere Program [IGBP] (2001–2006)
		Project Leader, International Geoscience Program [IGCP] no. 476 "Monsoon evolution and tectonics-climate linkage in Asia" (2003–2007)
		Co-Chair, Science Steering and Evaluation Panel [SSEP], Integrated Ocean Drilling Program [IODP] (2006–2008)
		Steering Committee Member, INVEST, IODP (2008–2010)
		Project Co-Leader, International Geoscience Program [IGCP] no. 581 "Evolution of Asian River Systems Linking to Cenozoic Tectonics, Climate and Global Geochemical Cycles" (2009–2013)
		Organizing Committee Member, 4th Annual Symposium of IGCP-476 "Monsoon, Tectonics, and Paleoclimate/Paleoceanography in East Asia and its Marginal Seas" (2006)

		Organizing Committee Chair, 5th Annual Symposium of IGCP-476 "Monsoon evolution and tectonics-climate linkage in Asia" (2007)
		Scientific Committee Member, PAGES 2nd Global Monsoon Symposium "Global Monsoon and Low-Latitude Processes: Evolution and Variability" (2010)
		Organizing Committee Member, 2nd Annual Symposium of IGCP-581 "Evolution of Asian River Systems: Tectonics and Climates" (2011)
Hiroko Nagahara	Prof.	Nomenclature Committee Member, Meteoritical Society (2006)
		Vice President, Meteoritical Society (2006–2007)
		President, Meteoritical Society (2008–2009)
		Past President, Meteoritical Society (2010–2011)
		Organizer, Workshop "Silicate Dust in Protostars : Astrophysical, Experimental, and Meteoritic Link" (2008)
		Organizer, Workshop "Mineral-water-organics in the early solar system" (2011)
		Organizer, Workshop "Mineral-water-organics in the early solar system 2" (2012)
Yutaka Abe	Assoc. Prof.	Member, International Commission on Planetary Atmospheres and their Evolution of the International Association of Meteorology and Atmospheric Science (2003–2009)
Gaku Kimura	Prof.	Organizing Committee Chair, French-Japanese International Workshop on Earthquake Source (2009)
		Organizing Committee Member, KANAME International Conference on a New Perspective of Great Earthquakes along Subduction Zones (2012)
Nobumasa Funamori	Assoc. Prof.	Program Committee Member, 22nd International Conference of High Pressure Science and Technology (AIRAPT-22) (2008–2009)
Tetsuro Urabe	Prof.	Vice Chairperson, 19th General Meeting Program Committee, International Mineralogical Association
Takashi Murakami	Prof.	Financial Committee Chair, 19th General Meeting of the International Mineralogical Association
Toshihiro Kogure	Assoc. Prof.	Nomenclature Committee Member (Representative in Japan), AIPEA (2007–2011)
Yohey Suzuki	Assoc. Prof.	Steering Committee Member and Session Convener, International Symposium on Subsurface Microbiology (ISSM) (2008)
Takanobu Tsuihiji	Lecturer	Organization Committee Member, 4th International Symposium of the International Geoscience Program Project No. 507 (2009)
Michinari Sunamura	Assist. Prof.	Steering Committee Member, InterRidge (2010–present)
Kazushige Tanabe	Emeritus Prof.	Nominations Committee Member, International Palaeontological Association (2011–2012)
		Organizing Committee/Scientific Committee Member, 7th International Symposium "Cephalopods: Present and Past" (2007)
		Scientific Committee Member, 8th International Symposium "Cephalopods: Present and Past" (2010)
		Organizing Committee Member, 2nd International Sclerochronology Conference (ISC2010) (2010)
		Scientific Board Member, 4th International Symposium "Coleoid Cephalopods Through Time" (2011)
		9th International Symposium, Cephalopods－Present and Past (Universität Zürich, Switzerland, Sept. 4-14, 2011), Scientific Committee member

VI. Public Partnership, Contribution to Societies and Outreach Activities

Faculty members in the department actively take part in various outreach activities such as public symposiums and seminars, delivery lectures and reports in the media including newspapers and TV programs. Below is a list of speeches in major public symposiums, public seminars, delivery lectures and TV appearances in the past six years. For other outreach activities such as newspaper reports, please refer to each faculty member's individual documents.

(1) Public Symposiums and Seminars

Name	Title	Public symposium and seminars
Kaoru Sato	Prof.	Invited talk "The whole earth's atmosphere observed from the Antarctic" Public Program: Top seminars of Earth and Planetary Science, Japan Geoscience Union Meeting, 2006, May, 2006
		Invited talk "Program of the Antarctic Syowa MST/IS radar (PANSY)", Hokkaido University Sustainability Weeks 2008, Symposium : Environmental Monitoring for Conservation of Ecosystems. Hokkaido University, 25 June 2008
		Invited talk "To explore of Earth climate system from the Antarctic" The Frontier of Science: Future of junior high and senior high school girls that is considered in School of Science, The University of Tokyo, 13 September, 2009
		Invited talk "Frontier the Antarctic atmosphere science explored by the MST/IS radar" Public lecture "Big Natural Science Close to Human Beings" School of Science, The University of Tokyo, 5 June, 2011
		Invited talk "Let big flowers bloom in the Antarctic!: The program of the Antarctic Syowa MST/IS radar (PANSY)" Yomiuri Techno Forum, Nippon Press Center, 17 June, 2011
		Invited talk "the Great East Japan Earthquake and Tsunami: Responsibility and Contribution of Universities", RU11 Symposium, September 2011
Toshiyuki Hibiya	Prof.	Invited lecture "Microscale phenomena in the deep ocean controlling the Earth's climate" (in Japanese), JFE Advantech, July 2008
		Commentary "The Abiki (tsunami-like huge ocean waves without any precursory phenomena) which attacked the west coast of Kyushu Island from February 24 through 26" (in Japanese), "Broadcast Station", TV Asahi, February 2009
		Commentary "What is the generation mechanism of the Abiki (tsunami-like huge ocean waves without any precursory phenomena) which attacked the west coast of Kyushu Island from February 24 through 26 ?" (in Japanese), "Sukkiri !!", Nippon Television, February 2009
		Invited lecture "Theoretical and observational studies of the global distribution of diapycnal diffusivity in the deep ocean" (in Japanese), Oceanographic Society of Japan, July 2009
		Invited lecture "Microscale processes in the deep ocean controlling the Earth's climate: Turbulent mixing in the deep ocean which drives abyssal water circulation" (in Japanese), Global Environmental College, October 2009
		"Development of human resources and several issues of postdoctoral researchers in the graduate school of oceanography" (in Japanese), Ooceanographic Society of Japan, March 2011
		Invited lecture "Microscale processes in the deep ocean controlling the Earth's climate: Turbulent mixing in the deep ocean which drives abyssal water circulation" (in Japanese), Oceanographic Command of the Maritime Self-Defense Forces, March 2012
Tomoki Tozuka	Assoc. Prof.	Photo exhibition by Japan Science and Technology Agency/The World Bank, October 2011
		Lecture "Another El Niño: Indian Ocean Dipole", Earth and Planetary Science Symposium "Climate Variation: Past, Present, and Future", May 2009
Yoshihiro Niwa	Project Assoc. Prof.	Lecture "Marine education based on Tsunami simulation", Public Symposium "Marine education for disaster prevention", University of Tokyo Ocean Alliance, August 2011

		Visiting lecture, Oita Tomei High School, December 2011
Naomoto Iwagami	Assoc. Prof.	"An infrared camera on board AKATSUKI" (in Japanese), Aogaku business forum, Aoyama gakuin, February 2011
		"Chemistry of Venus atmosphere", Planetarium workshop, Institute of Space and Astronautical Science, September 2009
		Astro-talk "Sending a camera to Venus!" Chiba science museum, January 2012
Takashi Mikouchi	Assoc. Prof.	"Big science news in 2006", Stardust mission, NHK Educational TV, Science ZERO, December 2006
		"What is comet?: Dusts returned by the Stardust spacecraft", Science Live Show "Universe", Science Museum, May 2007
		"Exploring rabbits on the moon", NHK Educational TV, Kagaku Daisuki Doyo Juku, November 2007
		"Mars through Martian meteorites", Space Agriculture Salon Meeting, Tokyo Yayesu Hall, September 2011
		Lecture "Exploring Mars: From Martian meteorites to Martian life", Ibaraki Nature Museum, January 2011
		"Exploring planetary formation in the solar system, What meteorites tell us", Wanna know more!, Door to astronomy and universe on the 2nd Sunday, Time Dome Akashi, October 2011
		Lecture "Meteorite research and Hayabusa mission", Nakagawa Elementary School, November 2011
		"Now at Faculty of Science! Approaching mystery of Itokawa", Science Museum, March 2012
Takaaki Yokoyama	Assoc. Prof.	Dept. EPS public seminars, UT Open Campus, August 2009
		Tanabata public seminar, Tsukuba Univ., July 2009
		NAOJ/NRO open campus, public seminar, August 2008
Yutaka Kondo	Prof.	Lecture at AGS, May 2009
		Lecture at Summer School of Meteorology, 2009
		Seminar at Laser Sensing Symposium, September 2009
		Lecture at Association of Corporate Executives, June 2010
Ryuji Tada	Prof.	Public Lecture "Catastrophic change of global environment and mass extinction caused by a bolide impact", Faculty of Science, University of Tokyo, April 2006
		Public Lecture "Catastrophic change of global environment and mass extinction caused by a bolide impact", National Museum of Emerging Science and Innovation, October 2007
		Public Lecture "Global environmental changes caused by a bolide impact", Space-guard Symposium, December 2008
		In-house Lecture "When and how the Taklimakan Desert formed?", Tokyo Geographical Society, February 2010
		In-house Lecture "Climatic Change and solar activity", Shinra-banshoh School on “Solar variability and the earth and planets", February 2010
		Science Café "How has the climate of the earth been controlled throughout its history?", Hitachi Environment Foundation, February 2011
		Science Café "Climate changes as the earth spins", Hitachi Environment Foundation, April 2011
		Science Café "How has atmospheric CO2 been controlled through time?: Deep water circulation and Biological Pump " Hitachi Environment Foundation, June 2011
		Science Café "The world of Day After Tomorrow: Abrupt climatic changes and their mechanism(s)" Hitachi Environment Foundation, August 2011

		Science Café "Solar Activity and climatic change: The day when sunspot disappeared" Hitachi Environment Foundation, October 2011
Hiroko Nagahara	Prof.	Lecture on Astromineralogy, Vacuum Exhibition, September 2007
		Talk "The precursor materials of planets and life", Association of astro-boys（Young Astronauts Club-Japan), June 2010
		Lecture "Mineral-water-organics in the early solar system", 11th Symposium of the National Institute of Natural Sciences, June 2011
		Lecture on Astromineralogy, Osaka Furitsu Univ., December 2011
Masahiro Ikoma	Assoc. Prof.	Public Lecture "What are super-Earths? Answering the mystery of giant Earth-type planets", June 2010
		Science Café, WaMuse, September 2010
		Lecture "Super-Earths", Asahi Culture School, January 2010
		Public Lecture "Various Planetary Systems in the Universe", Univ. of Tsukuba, July 2009
		Lecture "Planet Where You Live", Japanese Weekend School of Cote d'Azur, France, January 2009
		Lecture "Frontier of Astronomy: Emerging Exoplanets", Asahi Culture School, February 2007
		Public Lecture "Our Solar System and Other Planetary Systems", Suginami-ku Science Museum, November 2006
Satoshi Takahashi	Assist. Prof.	Donation of polished rock specimen of Permian-Triassic boundary for Iwate prefectural museum, June 2009
		Lecture, Iwate prefectural museum, July 2010
		Lecture, Kojunsya environmental research association, June 2011
		Carrier-up class for Ohkashiwa primary school, February 2011
		Carrier-up class for Suwadai Junior school, June 2012
		Lecture, Rainbow concert, October 2012
Hidenori Genda	Project Assist. Prof.	Public talk "Planetary Formation", Toda-shi public university, December 2009
		Provision of scientific information, "Cosmic Front" in TV (NHK BS), 2011
Nobuhiro Moteki	Project Assist. Prof.	Science Partnership Project 2011 "Investigation of macroscopic optical phenomena: The corona in meteorological optics", Maebashi High School, August 2011
Kazuhito Ozawa	Prof.	"Where is the border between rock and stone", Fuji TV, May 2011
		"Charm of earth science", lecture for high school students at Univ. of Tokyo, November 2012
Gaku Kimura	Prof.	Public lecture, "The 10000 m deep underground world found at Mugi," Mugi Town, 2007/3/25
		Lecture, "The Future of Geology and Geology World," Meeting of Hokkaido division of Geological Society of Japan, 2007.5.13
		Lecture, "Drilling the ancient plate boundary spray fault to investigate mechanism of megaearthquakes in suduction zones", Nobeoka high school, Miyazaki Pref., 2011.8.23
		Lecture, Science Café, Hitachi Environment Foundation, November 2011
Robert Geller	Prof.	Activities related to the March 11, 2011 Tohoku earthquake, such as articles in Japanese for the two major policy-oriented magazines in Japan (Sekai and Chuo Koron), interviews by several major TV stations (Fuji TV, Nihon TV, Yomiuri TV) and by international news channels (CNN, Bloomberg, Al Jazeera-English), and publication of a popular book on the problems of earthquake prediction in Japan

Yasutaka Ikeda	Assoc. Prof.	"The 2011 gigantic earthquake off Tohoku as part of the process of strain buildup and release in a subduction zone", 6th Public Symposium of University of Tokyo Ocean Alliance "Science of Earthquake Hazards", July 2011
Satoshi Ide	Assoc. Prof.	Lecture "Unknown earthquake-like phenomena nearby source areas of megathrust earthquakes", Public symposium of earth and planetary science, May 2007
		Lecture "Investigating governing laws of earthquakes", 13th public lecture of the School of Science, University of Tokyo, May 2008
		Open Campus Lecture, "Rupture process of the 2011 Mw 9.0 Tohoku-Oki earthquake", University of Tokyo, December 2011
Tsuyoshi Iizuka	Lecturer	Lecture "Earth, Water, and Life of the Ancient Earth", Seminar for high school and undergraduate students at Komaba, January, 2011
		Seminar on Geochemistry, Australian Department of Foreign Affairs and Trade, June 2009
		Seminar on Continental Growth History, Canberra Japan Club, February 2009
Tetsuro Urabe	Prof.	"Dream resources", TV Tokyo, February 2008
		World Business Satellite, TV Tokyo, July 2008
		"Rare metals", NHK, August 2009
		"Seafloor metal resources", News23, TBS, October 2010
		"Seafloor metal resources", Science Zero, NHK-E-tele, January 2012
		Public lecture, Shizuoka Kita Super Science High School, April 2008
		Public lecture, Omiya high School, November 2007
		Public lecture, Aoto Elementary School, June 2009
		Public lecture, Toride Daiichi High School, October 2009
		Public lecture, Oizumi Junior High School, September 2011
		Public lecture, Oizumi Junior High School, September 2012
Kazuyoshi Endo	Prof.	Public talk "Genes that form shells", Suginami Science Museum, November 2009
		Public talk "Cambrian Explosion", Kyoto Forum, January 2007
Toshihiro Kogure	Assoc. Prof.	"Fukushima nuclear accident #6: Seek solutions to radiological decontamination in soil and water ", Science- ZERO, NHK educational channel, February 2012
Takanobu Tsuihiji	Lecturer	Public lecture "Environmental adaptations of dinosaurs clarified through anatomical reconstructions", Suginami Science Center, February 2009
		Public lecture "Stegosaurus and its allies", Shizuoka Science Center Ru・Ku・Ru, February 2011
		Public lecture "Biology of dinosaurs: From anatomy reconstructions to growth and evolution", Symposium on Dinosaur Fossils in Tamba, Shiki no Mori Lifelong Learning Center, October 2011
Kazushige Tanabe	Emeritus Prof.	Public lecture "Nature and ammonites of Nakagawa Town", Nakagawa Town, September 2007
		Public lecture "Paleobiology of ammonites" Suginami Ward Science Hall, March 2008
		Public lecture "High-resolution ecological and environmental recors preserved in bivalve mollusk shell increments", National Museum of Nature and Science, November 2010
		"Dinosaur-Era animal's last meal found in its mouth", Discovery News, USA, January 2011
		Public lecture "Biological aspects of ammonites", Historical Museum of Hokkaido, November 2011
		"Ammonoid Paleobiology", Atsuo Fukada Memorial Symposium, Fukada Geological Institute, December 2011

Faculty members in the department conduct cooperative researches with companies and deliver lectures in cooperation with society.

(2) Cooperative Researches and Lectures in Cooperation with Society

Name	Title	Cooperative Researches and Lectures in Cooperation with Society
Hiroaki Miura	Assoc. Prof.	Tokio Marine & Nichido Fire Insurance Co., Ltd. Seminar (January 2011)
Hajime Kayanne	Prof.	Okinotorishima Workshop (2007–present)
		Eco-technological management plans against sea level rise through seminars, lectures and social media
Yutaka Kondo	Prof.	Lecture at Shikoku Electric Power Company (July 2008)
Kazuhito Ozawa	Prof.	"Investigation of formation mechanisms of microstructures of the solid earth with EBSD: Towards the understanding the evolution of the earth", 6th EBSD seminar, Oxford Instruments (June 2010)
Tetsuro Urabe	Prof.	Present-day significance of challenges addressing sea-floor hydrothermal ore deposits, 3rd Symposium for University of Tokyo Ocean Alliance ”New Connection between the Sea and Human” 2008/7
		An inquiry into strategy for exploration of sea-floor hydrothermal ore deposits, Research Institute for Ocean Economics, 2008/12
		"Sea-floor hydrothermal activity and underground ecosystem of microorganisms" Invited talk at International Medical Society of Japan Seminar, 2011/7/21
Kazuyoshi Endo	Prof.	Collaboration on pearly oyster genomes with Mikimoto (2011)

VII. Current Issues and Future Plans on Education and Research

(1) Basic Policy and Objectives

Recent rapid development of scientific technologies in earth and planetary science has broken down boundaries of academic disciplines and has expanded their research target fields, as can be seen in the cases of exoplanet research which resulted in cooperation of earth and planetary science and astronomy and of researches on proteins in fossils and DNA which resulted in cooperation of earth and planetary science and bioscience. Breaking down the boundaries of academic disciplines means that the foundation of research and education must be reconsidered radically.

Expansion of the research target fields by the renovation of scientific technologies can be seen in large-scale projects such as earth environment observation satellite mission, lunar and planetary exploration spacecraft mission, and space station development mission promoted by JAXA, earth simulator and next generation computer project, and ocean drilling program promoted by JAMSTEC. Through these large-scale interdisciplinary research projects, we must dramatically develop researches in earth and planetary science, and at the same time, provide various personnel with high expertise on researches, technologies, research management and consensus building over the long term.

Many of the large-scale projects promoted as part of national policy such as magnetosphere exploration, planetary exploration, oceanographic observation and construction of beam line for exclusive use in high-energy facilities require materialization of extremely huge projects for purely promoting earth and planetary science. Therefore, the department, through its pursuing researches and fostering personnel, has close connection to such promotion of researches. It is indispensable nowadays to foster personnel who have profound understanding and high abilities to develop their own researches and, furthermore, abilities to lead big projects. Qualities required for such personnel are flexible mind and ability to take action in order to firmly comprehend researches of the different areas and to promote joint researches. Moreover, internationality is essential for playing leadership roles in international joint researches, since such projects are often promoted through international cooperation.

On the other hand, relationship between earth and planetary science and human society has become much closer, through the aspect of natural disaster science or predictive science related to occurrence of earthquakes, volcano eruptions and abnormal weather, and through the aspect of environmental science related to global warming, desertification, climate changes and ozone crisis. Demands for contributing accomplishments in earth and planetary science to society have also become significantly high. The Great East Japan Earthquake occurred on March 11, 2011 and the radioactive contamination caused by the nuclear disaster have given serious assignments such as reassessing the ways of carrying out researches and education in earth and planetary science and reappraising relationships with society, politics and economics. Huge gap between seismology and historical sciences such as geology and geomorphology, owing to the historical background of academic establishment, would have been the biggest factor of causing the situation in which the expectations of the society were betrayed, and the term “unforeseeable” had to be used. Inevitable serious problems have been raised for earth and planetary science such as how to make society understand the difficulty of ‘prediction’ in complex systems, whether the information should be remitted without concealment of the truth or avoiding confusions in the society should be considered to the utmost extent in the state of crisis, and moreover, how we should be held responsible when involved in national policies including councils of ministries. The Department of Earth and Planetary Science of the University of Tokyo has been placed in the middle of such problems and recognizes that the continuing discussions have to be held, including on the ways of maintaining research and

education system.

Although the department faces such challenging problems, there is no doubt that we have to promote cutting-edge researches in the fields of earth and planetary science, develop the department into the world center of research and education and foster outstanding researchers and science engineers as social members who are responsible for the next generation.

(2) Current Issues and Measures

The followings are the major issues pointed out to be considered for improvement in the last external review held in March 2006.

(1) The department should make best efforts to identify the disciplines where critical advances are expected and encourage their development.

(2) The head of the department should play a leadership role in promoting the research programs strategically in the department. From this viewpoint, the department should give more than several years of tenure and delegate stronger functions to the head by electing a person highly qualified in both science and management. At the same time an executive group should be formed by representatives of research groups to assist the department head and accelerate the decision making. Administrative staff of the department should also be strengthened to reduce the burden on the department head.

(3) To assist future planning of the education program, we strongly recommend that the department conduct a survey of the graduates and see how successful the department has been in producing leading and influential scientists.

(4) To educate creative and leading scientists and contribute to advances of earth and planetary science in the international arena, students should be carefully screened for admission to the Ph.D. course, and it may be worth considering reduction of the ratio for students in Doctor to Master course.

(5) The department should keep up the measures for identifying and supporting outstanding scientists, and fostering of the younger generation will be strongly promoted.

(6) Independent minded researchers should share the common objectives, actively interact, and joint their forces to build an ambitious program.

(7) Further cooperation with the geochemistry group is recommended.

(8) Declined positions of assistant professors or research associate and shortage in the administrative and technical staff members have had negative effects on the improvements of education and research, and the times the faculty has to spend for management appear to have increased. The issue is obviously larger than this department is to deal with, but we hope that it will make best efforts to remedy the situation through strategic planning.

To respond to the above recommendations, the department has made efforts as follows for the past six years.

The department regarded (1) to be especially important, and immediately after the review, formed a working group consisting of six professors from the core groups chaired by the department head. The working group developed a blueprint for how the disciplines to be promoted should be selected as a whole department by having discussions not bound to the framework of the groups. After further discussions on the blueprint in the faculty committees, we have agreed on a basic policy for materialization of the blueprint plan through each personnel appointment. However, it was not easy in reality. The department has not successfully discussed on a new framework, and yet personnel appointments have to be made at the same time. Thus, the appointment processes have been carried out in the traditional framework of the groups.

As for (2), the department had discussions in the working group mentioned above and decided to extend the tenure of the head of the department to two years. Although it had not come to reality for several reasons of the faculty members, the department started adopting two-year tenure from this fiscal year. However, the administrative system and operating system are yet to be strengthened. Sabbatical system has also been discussed in the working group but has not been implemented yet.

As for (3), the department conducted a survey of the graduates. Many of those with Doctor's degrees have been appointed to termed postdoctoral positions. It takes about average of six years to be appointed to the positions without term. Furthermore, not many graduates are able to take the posts in research and education.

As for (4), the department tried to reduce the capacity of the doctoral and master's students and made application guidelines accordingly for the certain year. However, the department put back the capacity as before as a result of receiving guidance from Ministry of Education, Culture, Sports, Science and Technology and the Central office in the university. At present, solution to the problem is being discussed such that a department failing to fill the capacity should pass on the surplus capacity to a department with overcrowded students. On the other hand, screening standards for doctoral dissertations became immensely severe compared to those of six years ago. The department now requires students to publish at least one first-authored paper in English in an international journal before submitting a doctoral dissertation. Each student's academic advisor cannot be the chief examiner and the number of co-authors of the relevant paper shall not exceed two at the preliminary defense. The preliminary defense is held in public where not only faculty members but also other students are allowed to attend. Each dissertation is thus closely reviewed in a fair and objective manner.

As for (5), the department alone could not acquire GCOE program after the termination of the 21st COE program. However, a year later, GCOE program was granted in cooperation with Tokyo Institute of Technology. As shown in the data for this review, the department takes measures such as employment of over ten research assistants every year, sending doctoral students to international conferences, inviting specialists from overseas to give intensive lectures and supporting English courses. In the meantime, OIYR Program was launched in the same year, and the department has been sending graduate students overseas to stay at the world's leading research institutions for a month or two. In addition, Leading Graduate Course for Frontiers of Mathematical Sciences and Physics anchored by the Graduate School of Mathematical Sciences has been launched this fiscal year. The program supports three students per grade in the master's program and two students per grade in the doctorate program. Furthermore, the department applied to Grant-in-Aid for Establishment of Outstanding Graduate School Center and has received unofficial approval. The department will keep applying as much as possible for programs which support students and aims to establish a system in which every one of the doctoral students including JSPS fellowship recipients (DC1 and DC2) will be supported.

As for (6), the department has made discussions in the working group mentioned previously and agreed that the issue was extremely important and should be handled thereafter. Formation of a research subgroup to promote joint research with existing member is regarded as an important criterion when appointing a new faculty member, since it is very difficult for existing faculty members, who are in the same department but are not conducting joint researches with one another, to create a new system for joint researches. Formation of a subgroup is also encouraged to help developing larger scale researches when there are several personnel appointments among the relevant fields within a short period of time.

As for (7), Solid Earth Science Group has a lecturer in the field of geochemistry. In addition, cooperation with Geochemical Research Center and association with geochemistry group in

Earthquake Research Institute have been maintained.

As for (8), in order to cover the areas where assistant professors are unavailable, project assistant professors are employed by the external funds such as Grant-in-Aid for Scientific Research on Innovative Areas, Grants-in-Aid for Scientific Research and GCOE program. Part-time administrative staffs are employed by indirect expenses derived from management expenses grants and Grants-in-Aid for Scientific Research. These are attributable to numerous competitive funds acquired by the faculty members, and the department has to keep acquiring external funds to maintain the favorable conditions.

As stated above, some problems pointed out in the last external review have been improved to some extent, but there are unsolved or unimproved issues and emerging serious problems. The biggest unsolved problem is whether the department has been fulfilling the role expected of the University of Tokyo to provide personnel who can be in the forefront of both academic research activities and the society. One of the emerging issues is decreased enrollment in the doctorate program. These two issues are considered to be closely related.

In connection to the need for promoting research so as the department will become an international center, it was suggested in the last review that the department should make best efforts to identify the disciplines where critical advances are expected and encourage their development. However, under ongoing downsizing of the faculty, the department is compelled to allocate staffs to cover as much wide areas as possible, therefore allocating staffs intensively to certain research fields is not easy. In the meanwhile, with tightening international competition, intensive allocation of staffs can be said as an inevitable task for the Department of Earth and Planetary Science to become an international center in some fields of earth and planetary science.

For such purpose, the department has to formulate a grand design, strategically select certain themes and take measures such as initiating joint researches within the department, forming research subgroups, hosting international workshops, carrying out systematic cooperation and personnel exchanges of undergraduate and graduate students with international organizations. Fundamental overhaul of the organization modality including present group structure and future personnel appointments is becoming essential. Since twelve years have passed since the establishment of the department, faculty members have changed drastically, and moreover, a large number of faculty members will retire within the next few years. The department can be said to have reached the stage of having serious discussions on its modality. Furthermore, in order to revitalize research and education in the department, adjustment of unbalanced age structure of the faculty and introduction of sabbatical system are necessary.

In order to select research fields and concentrate staffs accordingly, it is necessary to reconsider the role of earth and planetary science in today's society. Academic fields of earth and planetary science have been expanded significantly by the growth of scientific technologies and increased demands for contribution of research accomplishments to the society. In the meanwhile, as manifested by the Great East Japan Earthquake occurred on March 11, radioactive contamination caused by the nuclear disaster and the terremoto dell'Aquila conviction, social responsibilities of earth and planetary science and each one of earth and planetary scientists are becoming extremely heavy. Not only the modalities of researches but also those of undergraduate education have reached the stage of severe re-examination. In order to provide education expected of the Department of Earth and Planetary Science, the department needs to firmly recognize its significance in today's situation, reorganize its education system accordingly and foster students with sociality and internationality.

Decreased enrollment in the doctorate program is a problem universal to all academic disciplines. Reasons behind this are serious postdoctoral fellows problem, decreased stable posts for

researchers, few job offers in the private sector for the graduates with degrees and stagnation of society as a whole. Since these are compound issues, it is not easy to discover a miracle drug by earth and planetary science alone. However, significant drop of the enrollment in doctorate program in FY 2008 after the termination of 21st COE program clearly indicates that financial support system for graduate students is an important factor. Fortunately, two thirds of the graduate students are financially supported at present through several measures including JSPS fellowships, employment of research assistants, although not enough in the number, by GCOE program and FMSP Leading Graduate Course launched this fiscal year. Furthermore, overseas internship program for sending young researchers including graduate students to international research institutions and the scheme for sending doctoral students to international conferences are successfully functioning. It is indispensable to keep acquiring such external funds. At the same time, it is also important to support master's students to some extent through various attempts. Furthermore, career placement services for the graduates with doctoral degrees should be reinforced more than ever.

(3) Future Plan and Development in Research and Education of Each Core Group

Based on the accomplishments up to date, the Department of Earth and Planetary Science aims to further enhance researches and education while maintaining the system of five groups basically. Each of the five groups has established its own objective, assignment to be resolved and future plan as below.

<Atmospheric and Oceanic Science Group>

The primary goal of the AOS group is to attain achievements at a high international level in each subgroup's research as well as cooperative research not only between the AOS subgroups but also with the Affiliated Institutions (the Atmospheric and Ocean Research Institute, the Research Center for Advanced Science and Technology), national institutions (the Japan Aerospace Exploration Agency, the National Institute of Polar Research, the National Institute for Environmental Studies, etc.), and foreign institutions (University of Hawaii, University of Washington, Princeton University, Seoul National University, Yonsei University, Ocean University of China, Northwest Research Associates, etc.). Through these research efforts, the AOS group aims to enhance knowledge on predictability of oceanic and atmospheric phenomena of great societal concern and provide leading figures in various fields of oceanic and atmospheric sciences.

• Atmospheric Physics:

With the aid of the development of super-computer and observational techniques, gravity waves, clouds, and turbulence which have been treated as subgrid-scale phenomena in most climate models are becoming explicitly resolved phenomena. Moreover, climate data since International Geophysical Years (1957-58) having sufficient quality to be analyzed by modern schemes are being accumulated. By combination of high-resolution numerical models (such as NICAM and KANTO), high-resolution observations, and large amount of data, and development of new theories which are needed for understanding these small-scale phenomena, advanced research and education will be made, in particular, regarding wave dynamics in terms of generation, propagation and dissipation, three-dimensional structure and variation of global material circulation induced by wave-mean flow interaction, and organization mechanisms of cloud systems.

• Physical Oceanography:

This research group aims to make a significant breakthrough in modeling the general ocean circulation and/or ocean-atmosphere interactions by introducing updated subgrid-scale information

such as turbulent mixing throughout the water column from the surface mixed layer down to the seabed in the deep ocean. In the near future, direct microstructure measurements down to rough abyssal sea beds will be made in the world's oceans including mixing hotspots such as the Indonesian seas. This will be accomplished using a multi-scale profiler (the microstructure profiler VMP-5500 equipped with a Seabird conductivity-temperature-depth (CTD) sensor and a geomagnetic current meter), which is only available at this research group in Japan. Fine-scale parameterizations of turbulent dissipation rates near mixing hotspots in the deep ocean and the performance of the modified Mellor-Yamada model in coupled ocean-atmosphere general circulation models will also be assessed.

• **Climate Dynamics:**

In addition to the research and education being conducted, this group plans to enhance understanding of interactions among phenomena with different spatio-temporal scales, which became possible with the use of high-resolution model simulation with high performance computers. Also, due to the recent climate change associated with the global warming, frequency and amplitude of climate modes may have been changing and this group will clarify relations between the global warming and climate variations.

• **Ocean-Atmosphere Material Circulation Physics:**

In order to create a new atmospheric science field by integrating atmospheric chemistry and physics, elementary processes (dynamic, physical, and chemical processes) will be studied through observations and integration of the system will be realized by developing numerical models that describe the elementary processes. Variability and circulations of oceanic substances will be also investigated by actively interacting with physical oceanography and other groups.

<Space and Planetary Science Group>

• **Space and Astrophysical Plasma:**

In the space and astrophysical plasma research, these 7 years between 2006 and 2012 were the period when the fundamental plasma processes of energetic particles that appears in many different venues are focused. In coming years, new developments are expected in the following subjects. (1) The particle acceleration and plasma heating during reconnection have been extensively investigated by means of satellite observations and theoretical/computational studies. We aim at advancing our understanding on reconnection, collaborating with laboratory plasma researchers. (2) The physics of collisionless shocks, which plays an important role in interplanetary shocks, supernova shock and astrophysical jets, has made important progresses. More advances will be made in this field collaborating with the astrophysical community. (3) The auroral formation observed by Reimei satellite as a small satellite exploration project discovered a fine structure that cannot be explained by the standard auroral acceleration mechanism, and this remarkable discovery has stimulated the physics of cross-scale plasma that coupled with the interaction of ionosphere and inner magnetosphere. We expect major advances in this field.

• **Solar Physics:**

In the field of solar physics, the solar dynamo and the surface magneto-convection are our new subjects. The goal of this study is to understand the generation of magnetic flux in the interior, its appearance on the surface and the formation of sunspots leading to the solar activities such as flares and CMEs.

• **Optical Sensing Planetology:**

In the Optical Sensing Planetology, there are several well-defined future plans. (a) The Venus mission AKATSUKI aiming at complete understanding of the long-standing problem 'atmospheric

super rotation' has been conducted. However, the orbit insertion around Venus failed in 2010, and the next chance is looked forward to at the end of 2015. (b) Meanwhile, ground-based spectroscopic observation of Venus has been conducted at around every inferior conjunction mostly using IR Telescope Facility of NASA at Mauna Kea, Hawaii. Airglow intensities, gas abundances such as of HCl, isotope ratios such as of D/H, and information of atmospheric wave structure have been quantified. Such studies will continue. (c) EUV (Extreme Ultra Violet) imaging observation of the Earth's plasmasphere from the Lunar mission KAGUYA has been made. Continued efforts to understand the plasmasphere will be made using such data. (d) EUV observation of He+ and O+ in the Earth's ionosphere from the International Space Station just started in Oct. 2012 and will produce valuable data. (e) Ground-based observation of Mercury at Haleakala, Hawaii succeeded to find its Na tail's elongation and variation. Marcurian environment will be studied using such data. (f) EUV observation of planets from the Earth-orbiting mission EXCEED will start soon in 2013. One of the main targets is S+ in the Jupiter-Io system. (g) Visible and EUV observations of Mercury from the Europe-Japan collaborating mission BepiColombo (to be launched in 2017) will investigate its neutral and ionized atmosphere such as of Na.

• Planetary Material Science:

One of the main targets in planetary material science is study based on isotopic and trace element analyses using secondary ion mass spectrometers. This study will be made collaborating with scientists at the Atmosphere and Ocean Research Institute and also the National Institute of Advanced Industrial Science and Technology. In particular, we will aim at solving problems on isotopic heterogeneities in the early solar system and will break new ground by developing analytical techniques of siderophile trace elements. Another direction of planetary material science is the technical development of ultra-small size samples. This has been applied to returned samples from Itokawa and will be applied to returned samples of the future Hayabusa-2 mission. In particular, we aim at acquiring crystallographic information, which would advance our understanding of evolution of extra-terrestrial materials. Also, we will study polymict breccias. This is because recent meteorite falls and the Hayabusa returned samples suggest that rubble-pile asteroids are of key importance for understanding meteorite parent bodies.

• Comparative Planetology:

In the field of comparative planetology, we did not have a faculty member during the last several years. We hope that the situation will change in the near future. Japanese missions such as Kaguya and Hayabusa have provided valuable data. NASA and ESA missions to Mars have produced enormous amounts of data many of which have not been utilized. Great advances are expected in this field.

Last but not least, we mention that star and planet formation is a common target of this research group. Protostars and star formation regions show various activities that are to be understood by plasma physics. Such activities must have affected solid materials (fine particles and large bodies), which are targets of material sciences. We hope that in the next several years, collaborations of various sub-groups will make advances in this field.

<Earth and Planetary System Science Group>

The Earth and Planetary System Science Group aims to understand the mechanism of formation, dynamics, and stability of planetary systems, our solar system, and individual planetary systems. The initial conditions of those systems are not known, and they have suffered evolution as complex systems, which mean that we can know all the evolution processes neither in forward way nor in backward way. We cannot fully understand the behavior of the systems only from observations of

the present Earth or other planets because of the nature of complex systems, either. The EPSS group thinks that both forward and backward approach should be combined for better understanding of the behavior of the system. Consequently, we will keep current style of research and education that both forward and backward approach should be applied in our science. Current themes of the EPSS group are summarized below.

- Construction of evolution model of precursor materials of planets and life in protoplanetary disks.
- Understanding the diversity of planetary composition and internal structure by both theoretical and observational approaches
- Developing theories of planetary evolution that is dictated by interaction between surface environment and solid interior
- Understanding the common and unique properties of the Earth among various planets in and beyond the solar system
- Extending theories of planetary evolution for understanding the diversity of climates of terrestrial planets
- Development of observational methods for evaluating the diversity of surface environments of exoplanets
- Evaluation of the radiative effects of aerosols based on aircraft and surface observations using advanced measurement technologies
- Estimation of the effects of aerosols on clouds and precipitation based on observations and numerical models
- Theoretical studies of aerosol optical properties, especially precise calculations of scattering and absorption by non-spherical particles
- Development of advanced models, which include precise microphysics and chemistry of aerosols and their applications to the Asian regions
- Response of coral reef to the global changes as a key ecosystem.
- Observation and modeling ecosystem resilience against environmental stresses.
- Relationship between water circulation in the eastern Asia and global monsoon in Holocene
- East Asian monsoon and the jet flow of prevailing westerlies in the recent 10 m.y.
- Drastic change of the Earth's environment and the time temporal and spatial response and recovery of living systems

The EPSS group is and will be an international leading team of individual field of (1) co-evolution of interior and surface of planets, specifically that of habitable planets, and analysis of surface environment of habitable planets by astronomical observation, (2) evaluation of the role of aerosol in climate change, (3) dynamics of the Earth's surface environment and response of ecological system, and (4) the relationship between climate change and environment in the eastern Asia.

Development of graduate students who get interested in studying the earth and planetary systems with special interests in the behavior of systems and deep knowledge of theoretical background is the crucial issue of the EPSS group. They will be leaders of scientific and public communities. Fortunately, many young outstanding staff members have joined us in these two years, which will surely be very effective for development of graduate students.

<Solid Earth Science Group>

The aim of the solid Earth science group is quantitative and comprehensive understanding of

the "solid earth," i.e., the crust, mantle, and core (including the liquid outer core). We study its physical and chemical state and structure and its formation and evolution on various temporal and spatial scales, and the physical and chemical interaction between its various layers. Our group consists of the following subgroups: earthquake science, tectonics, evolution of the solid earth, and dynamics of the earth's interior. We are making every effort to facilitate interaction between these subgroups to achieve development of a unified and seamless view of the solid Earth.

• Earthquake Science:

To achieve a comprehensive understanding of earthquake rupture, we seek to increase our knowledge of microscopic physical and chemical processes and the hierarchical heterogeneity in seismogenic systems. We study both the extent to which earthquakes can be forecast under long-term stress loading, and the limitations on predictability. We are studying earthquake faults and surrounding structures, based on the large-scale investigation of tectonic landforms, deep underground drilling, and the laboratory-scale observation of fault materials. Physical mechanisms and the conditions governing seismogenesis and earthquake scaling relations are constrained by analyzing large volumes of high quality seismic and geodetic data, analytical and numerical simulations, and experiments using analog materials. We also have developed methods to model seismogenic processes with uncertainty under various loading conditions. We will integrate observations, experiments, data analyses, and theoretical calculation, working in collaboration with groups studying dynamics and evolution of the mantle.

• Tectonics:

One of our research objectives is to reveal the fault mechanics in seismo-tsunamigenic plate subduction boundary. We actively participate in the Integrated Ocean Drilling Program, especially Nankai Seismogenic zone experiments and others and investigate the fault mechanics of the plate boundary and splay fault breaching from the boundary. We also investigate a fossilized plate boundary and splay faults, which were exhumed from the depth more than ~10km deep and now exposed on land, compare with physical properties and state of the modern fault, and accomplish the scientific objective. Another objective is to understand the evolution of large-scale orogenys caused by content-continent collision. We organize a China-Japan cooperative research group, which attempts to reveal the process and mechanism of the lateral growth of the Tibetan Plateau at its northeastern margin.

• Evolution of the Solid Earth:

To improve our understanding of the evolution of the solid Earth we require better knowledge of geodynamics and the thermal conditions of crustal formation and crust-mantle interaction over geological history. We are conducting geological, mineralogical and geochemical studies on crustal and mantle rocks and minerals with ages ranging from 4.4 Ga to the present. We are also conducting mineralogical and geochemical studies of extraterrestrial materials such as meteorites and lunar rocks, since extraterrestrial samples provide valuable constraints on the origin and earliest evolution of the terrestrial planets. By combining perspectives from terrestrial and extra-terrestrial samples with insights from high-pressure experiments and modeling, we will study how the geodynamic and thermal state of the solid Earth have evolved with time and which parameters have played the most critical role.

• Dynamics of the Earth's Interior:

We are carrying out work on developing and applying algorithms for using high performance computers to invert seismic body-wave waveform data for high resolution localized 3-D earth structure and to conduct numerical simulations of geomagnetic reversals at low viscosity for strong magnetic field energy in a metallic core. We are also carrying out new types of high-pressure in situ

experiments using high intensity coherent X-ray beams with the goal of studying heterogeneous material properties in the deep interior of the Earth and planets. Heterogeneity of material properties has a strong influence on geodynamics, while, conversely, geodynamic processes serve to cause heterogeneity. We will carry out the above projects with the goal of combining the results obtained by the various approaches to achieve a unified understanding of the state and evolution of the deep interior of the Earth and planets, and the effects engendered by the interaction of the various phenomena and layers.

<Geosphere and Biosphere Science Group>

Promoting research and education on geosphere-biosphere interactions will continue to be the major aim in our group. The faculty members in our group have been changed greatly during the last few years in order to encompass innovative fields in geosphere and biosphere science. Establishment of a new collaborative regime within the group is of prime importance for each member of the group to achieve better research and education and proceed closer to the ultimate goal. Research collaborations with scholars from other fields, such as agricultural scientists, chemists, and biologists started in 2000, and are equally important: the study themes cover various research fields including biomineralization, interface processes between organic and inorganic compounds, microbiological and chemical processes at deep-sea hydrothermal vents, organic geochemistry, long-range mutual biological interactions and evolution, and water-rock-air interactions. It should be noted that these studies contain various seeds for new research fields, and we will continue to make many of them flourish as an integral part of the earth science in the next several years. We believe that one of the fundamental aspects of our group resides in the primary data acquisition on the basis of fieldwork, analyses on natural specimens, laboratory experiments, and measurements. We will pursue this direction both on our research and education.

We aim to take the leadership in research and education of the geosphere and biosphere science in Japan. In order to achieve this goal, we will organize large projects through cooperation with other research groups in our department, the Atmosphere and Ocean Research Institute, and the University Museum of the University of Tokyo, as well as JAMSTEC and the Geological Survey of Japan (AIST), and try to make an international contribution to this important research field.