Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

U01-01 Room:IC Time:May 26 13:25-13:40

JpGU Promoting International Collaboration in the Geosciences

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Japan Geoscience Union (JpGU) is the academic organization that represents the geoscience community in Japan. It consists of over 50 member societies and about 10,000 individual members including researchers, technologists, students, educators, science communicators and interested members of the general public.

JpGU was officially recognized as a public service corporation on the 1st December 2011. JpGU acts as a forum for the exchange of information and the collection of opinions and ideas within the diverse geoscience community. Our academic activities are focused on the following five sections: space and planetary sciences; atmospheric and hydrospheric sciences; human geosciences; solid Earth sciences; and biogeosciences. We hold an academic meeting, the JpGU Annual Meeting, every year in the spring, issue a newsletter and work to provide relevant geoscience information to society at large. In 2014 we also launched a new geoscience open access e-journal, Progress in Earth and Planetary Science (PEPS).

Geoscience is the area of natural science that deals with the Earth, the other planets and, on a larger scale, with the whole of the solar system. On the Earth it aims to understand the dynamics governing the evolution of both natural phenomena and social systems. It also aims to clarify the essential features that contribute to the existence and evolution of life. Geoscience can be divided into pure and applied areas, the first concerned with increasing our understanding of natural phenomena and the second with using this knowledge to help to deal with environmental problems, to mitigate natural disasters and so on. Geoscientific knowledge is relevant to many of the problems facing mankind and geoscientific research is indispensable if we wish to maintain the continued prosperity of our species. As a pure discipline, geoscience offers us a birds-eye view of the natural wonders of the planetary system in which we live. As an applied science it includes cultural and social elements which allow us to construct a new paradigm that offers the hope of resolving many of the problems facing mankind.

In order to provide solutions and see them adopted by society, the geoscience community must continue with scientific research but also work to educate society at large and to communicate our message to the general public and our political leaders. JpGU aims to promote research and also to increase the understanding of geoscience issues in the general public, therefore, we encourage the exchange of information and collaborations among researchers in geoscience societies, and promote public relations to ensure that important information is communicated to society at large. We seek to ensure the continued vitality and importance of geoscientific research in Japan, the Asia Pacific region and worldwide.

U01-02 Room:IC Time:May 26 13:40-14:05

Geoscience Ahead: A European perspective

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Geosciences are as important as ever to society in relation to a broad range of challenges. Our geoscience subjects are central to six of the global top ten challenges to society, including the supply of fresh water to the whole population, stable supply of energy, the climate evolution and severe weather conditions, stable and sufficient food supply where soil sciences is at the centre, geohazards, and ocean acidification. The political solutions to these key challenges require scientific knowledge and insight, and learned societies should assume a key responsibility in defining the challenges. The science advice to the political world will come from a variety of organisations, and it is reassuring that ICSU recently has launched its new flagship programme on "Future Earth". However, the geoscience unions should also play a key role in ensuring that society has the best scientific insight before decisions are made to these grand challenges. The unions with their broad membership, geographically and subject-wise, have the organisation that may foster increased international collaboration on the key challenges across the borders.

The European Geosciences Union (EGU) is Europe's premier geosciences union, dedicated to the pursuit of excellence in the geosciences and the planetary and space sciences for the benefit of humanity, worldwide. It was established in September 2002 as a merger of the European Geophysical Society (EGS) and the European Union of Geosciences (EUG), and has headquarters in Munich, Germany. EGU is a non-profit international union of scientists with over 12,500 members from all over the world. Membership is open to individuals who are professionally engaged in or associated with geosciences and planetary and space sciences and related studies, including students and retired seniors.

The EGU has a current portfolio of 16 diverse scientific journals, which use an innovative open access format, and organises a number of topical meetings, as well as education and outreach activities. Its annual General Assembly is the largest and most prominent European geosciences event, attracting over 13,000 scientists from all over the world. The meeting's sessions cover a wide range of topics, including volcanology, planetary exploration, the Earth's internal structure and atmosphere, climate, as well as energy and resources.

Europe is a diverse continent with many small countries. Although many countries are members, the European Union (EU) has limited influence on the policy making in Europe (e.g. laws require decision in all parliaments in the member countries). Nevertheless, the political system in Europe develops toward integration between the members of the EU. The disciplinary breath and its large membership provide excellent background for EGU to assume a role in assisting policy makers by providing scientific advice.

EGU is already a premier forum for open debate on the role of geosciences in modern society and development of new relations between scientists and the political system. We are now taking up the challenge and responsibility of promoting geosciences in a wider context to society, including promoting research opportunities for talented early career researchers, and providing links between decision makers, the political system and the scientific community. Outreach in terms of information sharing with the public is already at a high level and the ambition for the coming years is that EGU's voice should be heard among the coming generations of scientists, politicians, economists, and other decision makers throughout Europe. Being the premier geoscience union in Europe, EGU has a commitment to provide reliable scientific information to society, in particular to the main global scientific challenges faced by our societies. On global scale, the geosciences unions should consider joint action in identifying the key questions in relation to the key global challenges.

Keywords: EGU, EGS, EUG, EU, Future Earth

U01-03 Room:IC Time:May 26 14:05-14:30

Intensify co-operation among geo-science communities to cope with the challenges of the years to come

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On behalf of Asia Oceania Geosciences Society (AOGS), I sincerely congratulate Japan Geoscience Union (JpGU) on his silver anniversary.

AOGS was established in 2003. Its mission is to promote geosciences and its application for the benefit of humanity, specifically in Asia and Oceania and with an overarching approach to global issues. Since it was established, AOGS has developed steadily. Over 1,000 geo-scientists in Asia and Oceania attend AOGS annual convention to present the latest results of their research and exchanging scientific knowledge.

In the process of economic construction and social development humanity faces serious difficulties such as resource shortage, energy crisis, environment pollution, damage of ecological balance and frequent occurrence of disasters, etc. These difficulties or challenges are mostly directly or indirectly related to the geo-scientific and geo-technological issues. It is geoscientists' bounden duty to make every effort to cope with these challenges by improving our understanding of the nature of these geo-scientific phenomena through scientific and technical approaches.

It is well known that the geo-scientific phenomena are not defined by national boundaries. In recognizing this nature, AOGS has devoted its efforts not only to intensify scientific exchange and co-operation, but also to develop good co-operation with other international geo-science societies and unions such as the European Geosciences Union (EGU), American Geophysical Union (AGU), International Union of Geodesy and Geophysics (IUGG), Japan Geo-science Union (JpGU), and Science Council of Asia (SCA).

AOGS pays special attention to public participation of coping with the challenges we faces, and has been active in the public outreach. The public participation is considered to be an important factor for increasing awareness of the problems that the whole society confront.

I greatly appreciate JpGU for generous invitation and providing a unique opportunity to exchanging scientific knowledge and discussion to address important geo-scientific issues among scientists. I sincerely congratulate JpGU on his success in the past 25 years, and wish JpGU a prosperous prospect in the years to come.

Keywords: AOGS, IUGG, SCA

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U01-04 Room:IC Time:May 26 14:30-14:55

AGU: Global collaboration for the Earth and space sciences

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The American Geophysical Union (AGU) will celebrate its centennial in 2019. The AGU represents 60,000 geoscientists as members (including over 24,000 members outside of the USA with almost 2,600 from Japan) while reaching over 300,000 scientists through its global meetings and publications programs.

As geoscience has grown to know no borders, so has the AGU. Our Fall Meeting held in San Francisco includes scientists from almost 150 countries, and over half of the articles published in AGU journals are from lead authors outside the USA.

Keywords: AGU, history, international, community, partnership

U01-05 Room:IC Time:May 26 15:15-15:35

A personal future perspective of international collaborations in space physics

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Space physics is a research field that has developed rapidly along with the dawn of the space age. The international collaborations have been one of key elements of researches in the space physics. Interdisciplinary researches are also fundamental nature of the research field, since it has close relations with astronomy, meteorology, planetary science, plasma physics, and other fields. In recent years, it has further developed roughly in three directions. One direction is contribution to understanding of universal plasma processes in the universe such as the magnetic reconnection, plasma turbulence, and shock waves, utilizing the 'in-situ' plasma observations that enable direct measurements of space plasma phenomena in the solar system. In this direction, the launch of NASA's formation flight mission called MMS (Magnetospheric Multi-Scale) is schedules in March 2015 with instrument-level collaboration between US and Japan. The main goal of the mission is to reveal the nature of the microphysics of three fundamental plasma processes, i.e., the magnetic reconnection, energetic particle acceleration, and turbulence. Interdisciplinary researches between space physics, astronomy, and laboratory plasma physics have been enhanced.

The second direction is the understanding of dynamic variations of Geospace environment. A wide scope of researches from basic studies of physical mechanisms to applications to space weather forecast has been deployed worldwide. In this direction, international geospace exploration is underway: NASA's Van Allen Probes has provided new data since their launch in 2012, and in Japan, preparation of the ERG (Energization and Radiation in Geospace) mission is ongoing for scheduled launch in summer 2016. Regional couplings are key elements in this direction of researches, and the solar wind-magnetosphere-ionosphere-thermosphere interactions have been investigated. The international programs such as ISTP, CAWSES, and VarSITI have played important role in promotion of international collaborations.

The third direction is expansion to the comparative planetary researches. Each planet in our solar system has different properties in terms of size, weight, distance from the sun, atmosphere, and intrinsic magnetic field. Particularly, characteristics of atmosphere and structure as well as strength of intrinsic magnetic field are important parameters to determine space environment around a planet. The knowledge of other planets with different conditions enables us to understand more deeply the solar-terrestrial system. International mission to Mercury, BepiColombo is now under preparation and will be launched in 2016. The mission consists of two orbiters and one of the orbiters, MMO, has been developed in Japan, while ESA is responsible for MPO development. The mission has also enhanced international collaborations in science before launch. There are many other missions that have excited international collaborations such as MAVEN and JUICE. In order to understand the diversity and universality of the stellar-planetary system, cooperation with astronomy and planetary science is getting more essential. This presentation provides a brief review of these international collaborations in space physics. Keeping these three directions of researches, a personal future perspective will be also presented.

Keywords: magnetosphere, ionosphere, planetary exploration, space physics, space plasma, solar-planetary system

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U01-06 Room:IC Time:May 26 15:35-15:55

Model-based climate research on global change: Challenges for the future

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Climate sciences have evolved rapidly during the past decades as observations suggest gradual changes in weather and climate due to increasing anthropogenic radiative forcing. General circulation models (GCMs) have also been developed and improved, though incrementally, for attributing the past climate change signals as well as for future climate projection. International efforts of coordinating the GCM experiments, called the Coupled Model Intercomparison Project (CMIP), have provided information on climate changes imperative to the IPCC Assessment Reports.

We, a joint climate modeling group among the University of Tokyo, National Institute for Environmental Science, and Japan Agency for Marine-Earth Science and Technology, has developed a state of the art GCM, called MIROC, which participated in past CMIPs. Using MIROC and simulations with other CMIP models, we have carried out several attribution studies, including increasing frequencies of Northern Hemisphere heat waves, Indonesian drought, and Eurasian cold winters over the last decades. I present those examples of the climate change attribution in this presentation, followed by a recent issue of the global warming 'hiatus'. Despite climate change signals being apparent from observations and model simulations, global mean surface air temperature has increased little over the past 15 years, which is contrasting to a rapid increase during the late 20th century. This stall in temperature increase has attracted attention from both climate science community and society. In order to explore the mechanism of the warming hiatus, we performed ensemble historical simulations using MIROC with prescribed surface wind stresses over the tropical oceans. Unlike conventional CMIP simulations, our simulation well reproduced the warming hiatus, suggesting a vital role of the tropical wind changes associated with decadal-scale natural fluctuations. A combined analysis to the MIROC ensemble simulations enabled us to assess relative contribution of the human induced external component and natural variability to the past decadal temperature changes.

Current debate on the warming hiatus indicates that our understanding of the climate system, such as the energy budgets, ocean heat uptake, climate feedbacks, and global mean temperature change, is not yet sufficient. I outline these challenging issues for global change, and introduce possible ways for further progress, which include the coming 6th phase of CMIP, ultra-high-resolution global simulation, new measurements with satellites, and use of palaeo records.

Keywords: Climate science, General circulation model, Climate change, CMIP

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U01-07 Room:IC Time:May 26 16:15-16:35

Coral reefs in a changing world: climate change and land-based pollution issues and conservation strategies

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Tropical and subtropical islands are associated with coral reefs, which provide ecosystem services, including fisheries, tourism and coastal protection. This is especially true to reef islands that are composed fully of reef-derived materials. Both global-scale (climate change) and local-scale (land-based pollution) have been causing significant change on coral reefs.

Japan provides an ideal setting to examine these changes, because it covers a wide latitudinal range, stretching from subtropical to temperate areas, and latitudinal limits of coral reefs and coral distributions are observed around the Japanese islands. Seas around Japan showed significant sea surface temperature (SST) rises in winter, which is critical for corals to survive at the latitudinal limits of their distribution. In addition, some islands have significant amount of sediment discharge through rivers as a result of extensive land development. So land-based pollution issues can be examined.

In the southern part of Japan, mass coral bleaching occurred in 1998, 2001 and 2007. These events were driven by anomalously high SSTs in summer, which suggests that rising SSTs would cause higher frequency of bleaching. On the other hand, range expansion of corals was observed around the mainland Japan. We collected records of coral species occurrence from eight temperate regions of Japan along a latitudinal gradient since the 1930s, and detected four species showed range expansions, with speeds of up to 14km/year.

Future projection of coral reef status would require consideration of another important issue, ocean acidification, caused by dissolved CO_2 in seawater. Higher concentration of dissolved CO_2 cause reduction in aragonite (one of the forms of $CaCO_3$ that construct coral skeletons) saturation state (Ωarag). We used climate model outputs for SST and Ωarag and present-day their threshold values for coral distribution to project future coral habitats. Without consideration of coral adaptation and/or acclimation, in high CO_2 emission (SRES 2A) scenario, coral habitats will be lost in the 2070s because of higher SST in the south and lowered Ωarag in the north. On the other hand, lowered CO_2 emission (SRES 1B) scenario, coral could survive in the southern part even in the 2090s. This strongly suggests the importance of reducing CO_2 emission for conservation of corals.

Extensive land development and modification caused significant increase in sediment discharge, which is called "red-soil discharge (RSD)." A 15-year monitoring results showed no recovery of corals at sites affected by RSD, while a site without RSD showed recovery of coral cover. This means that reducing other stressors such as land-based pollution would be an effective way to enhance resilience of corals to bleaching, in addition to reducing CO_2 emission. Because sediments are derived from farmlands, integrated framework to consider land-sea connections and regional economy, i.e., setting biodiversity conservation targets, identifying sediment source areas by monitoring and modeling, and estimating costs for preventing sediment discharge from farmlands, is needed, in order to prioritize the farmlands to conserve river and coastal ecosystems.

Marine protected areas (MPAs) are an effective tool for conserving coastal ecosystems. Identifying the candidate areas based on rigorous scientific knowledge is required. Generating large-scale databases for species distribution and physical environments would contribute to set up new MPAs for conserving biodiversity. Further, because distributional ranges are shifting/expanding, marine protected areas that incorporate these shifts/expansions are required. Integration of climate model outputs and spatial planning would help identify the areas. A data-based, spatially-explicit, transdisciplinary approach is required for future conservation of coral reefs in a changing world.

Keywords: environmental change, coral reef, climate change, land use, ecosystem conservation

U01-08 Room:IC Time:May 26 16:35-16:55

Broadband Earthquake Science

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A huge earthquake can significantly change the atmosphere of our society. Although a practical scheme for predicting future earthquakes has been one of the most desired research products in earth science, it yet remains totally unrealized. Rather, increasing knowledge on the rupture process of earthquakes reveals how and why the deterministic prediction of earthquake is difficult. While each dynamic rupture process obeys deterministic physical laws, the nonlinearity in these laws and the complexity of hosting fault systems limit our predictability. Thus, rupture apparently behaves like a stochastic process, which is only probabilistically predictable.

In one extreme view, an earthquake is a randomly growing rupture process starting from a tiny nucleus. The growth is scale independent and the final size of each event is almost unpredictable by observing the initial stage. However, this view is not always correct. Sometimes, high regularity is observed in size and timing for a group of earthquakes, such as well-known repeating earthquakes in the Tohoku-Oki region. Such regularity cannot be ruled out by randomness and must be related to the characteristic structure in seismic regions. Therefore, the quantitative understanding of structural heterogeneity is an important task for probabilistic forecasts of seismic activity.

Structural heterogeneity in seismic region has been considered using a locked region, which is often loosely defined as "asperity", in the sliding background. The background was considered as an unobservable imaginary system, like a steadily slipping plate interface. However, this perspective has been changed by recent discoveries of "slow earthquakes" in many places worldwide. The background is probably the place where spatially and temporally variable slow deformations occur. Unlike ordinary earthquakes finishing in several hundred seconds at most, slow earthquakes continue for hours, days, and even several months. Slow earthquakes controls stress loading in seismogenic region and may precede very large earthquakes. There is some evidence for the effects of atmosphere and ocean on seismic activity, probably through slow earthquakes, which are susceptible to small stress change. To understand slow earthquakes and their effects on fast earthquakes, we need very broadband observations and modeling of tectonic system.

Keywords: earthquake, slow earthquake, dynamic rupture, scaling

U01-09 Room:IC Time:May 26 16:55-17:15

Biogeochemistry of life-inhabited planets: Lessons from Early Earth

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Among planets so far we know, only the Earth is known to harbor life. Therefore, environmental condition of early Earth must have been essential for origin of life as well as for subsequent evolution of biosphere. Chemistry of the early atmosphere and ocean is still largely uncertain, though recent geochemical investigations allow us to understand redox state of the early Earth. The anomalous isotopic ratio (S-MIF) recorded in sedimentary rocks only before 2.3 billion years ago indicate that the pre-2.3 Ga atmosphere was virtually devoid of molecular oxygen (Farquhar et al., 2000). Photolysis of SO2 in an O2-poor atmosphere has been the only known process that produces the large sulfur isotopic anomaly. Atmospheric model calculation has indicated that a reducing atmosphere (pO2 $<$1 ppm) is required for preserving the atmospheric isotopic anomaly into geological record, otherwise all the atmospheric sulfur species can be oxidized into sulfate before deposition and thus erase the isotopic anomaly (Pavlov and Kasting, 2002). Based on isotopic fractionation factors determined by a series of our laboratory experiments, we have suggested that the preservation of the S isotopic anomaly requires low CO2 well below 1 bar, instead including other reducing gasses like H2, CH4 or CO (Danielache et al., 2008; 2012; Ueno et al., 2009; in press). In such a reducing atmosphere, photochemistry should have been an important source of simple organic compounds like aldehydes and carboxylic acids that can drive prebiotic synthesis. The organic species and their flux are changed by redox condition of the system. The presence of ocean together with its reducing capacity from dissolved ferrous iron may have played a key role for chemical evolution before origin of life.

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International activities of the Science Council of Japan toward the future of earth and planetary science

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In this invited talk, various academic activities of the Science Council of Japan (SCJ), including international collaborations, are introduced. The Committee of Earth and Planetary Science (EPS) of SCJ have more than 70 scientists, comprising 14 subcommittees nine of which are for international collaborations. As an organization under the Cabinet Office, SCJ offers financial contributions to ICSU and its related international organizations, including IUGG, IGU, SCAR, IUGS, IMA, COSPAR, SCOR, SCOSTEP, INQUA, IASC, ICA and WCRP, while having active commitment to the Future Earth program. In parallel, scientists in the nine subcommittees support specific activities of the corresponding international organizations, by acting as members of executive committees or scientific steering committees and conveners of international conferences and by hosting international conferences in Japan. These activities of the EPS Committee of SCJ are overall complementary to those of JpGU and related academic societies that are supported directly by individual scientists. For further progress in academic activities related to earth and planetary science, it is therefore essential for the EPS Committee to further tighten its relationship with JpGU, supporting its linkage with AGU, EGU and AOGS.

Keywords: earth and planetary science, Science Council of Japan, international collaborations