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

U05-01 Room:103 Time:May 25 09:15-09:45

On the development of Future Earth in Asia

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Future Earth is a global research platform designed to provide the knowledge needed to support transformation of society to a sustainable world. We seek to build and connect global knowledge to increase the impact of research and to find new ways to accelerate transitions to sustainable development. Future Earth will contribute to achieving the goals of the high level UN General Assembly resolutions on global sustainability, as articulated at the 2012 Rio+20 Summit and subsequently. Future Earth will work with partners in society to co-develop the knowledge needed to support decision makers and societal change by focusing on three Research Themes ? Dynamic planet, Global sustainable development and Transformations towards sustainability.

Here, I would like to emphasize the important role of Future Earth particularly in Asia. This region as a whole is characterized by rapid population and economic growth and urbanization, where great disparities of wealth both within and between countries, and social and ecological vulnerability to the potential impacts of climate change are increasing. Associated with this rapid population & economic growth, this region has become a huge hot-spot of greenhouse gas increase, air and water pollutions, affecting regional to global climate change. In addition, this region is located in the midst of monsoon climate and the huge active tectonic zone. These natural conditions cause high frequency of natural disasters, but also provide rich natural resources for agriculture & fisheries. The science community and society should tightly collaborate particularly in Asia to form Future Earth in Asia initiative, including the tight collaboration with IRDR. I do believe that without achieving sustainable society in Asia we cannot achieve global sustainability.

Keywords: Environmental problems in Asia, Futurability, sustainability, natural disasters, Future Earth, Human-Nature interactive system

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SOUSEI Program for global change projection: results and future development

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The Program for Risk Information on Climate Change (SOUSEI) is a national project for projection of global change, with an aim to generate information to evaluate the probability of the occurrence of extreme events and the risk of various disasters, damage, etc., and to play a role in risk management. This project began in FY2012 and will continue for five years. The project′s specific research is divided into five themes which are being pursued concurrently, as follow. Theme A: Prediction and diagnosis of imminent global climate change, Theme B: Climate change projection contributing to stabilization target setting, Theme C: Development of basic technology for risk information on climate change, Theme D: Precise impact assessments on climate change, and Theme E: Promotion for climate change research and linkage coordination. Theme A focuses on the development of the basic model that is the basis of this program. In this program′s precursor, the Innovative Program of Climate Change Projection for the 21st Century, research on the basic model was also driving the overall program, but in the current program, we aim to strengthen the basic model itself and to add more advanced functions. Theme B has a sibling relationship with Theme A. It adds elements such as the environmental biogeochemical cycles and biological activity to the basic model, develops a more detailed earth system model, and studies target levels for stabilization of the climate. The aim of Theme C is to extract more detailed prediction information and to describe the ″conceivable scenario″ including the probability of a particular scenario occurring, such as Isewan Typhoon (Typhoon Vera). In response, Theme D aims to produce risk projections and assessments to provide adaptation to minimize the impact to natural hazards, water resources and ecosystem and biodiversity under climate change. Theme E is unique in that it is dedicated to supporting other research themes (Theme A-D) including technical issues, such as establishment and maintenance of data storage server with ˜3PB data space. Theme E is also expected to link SOUSEI Program with another IT project in Japan, i.e., Data Integration and Analysis System (DIAS), which in turn is serving as the Japan Node for the Earth System Grid. In the presentation, results obtained so far under SOUSEI Program and ongoing coordination in Japan regarding preparation for CMIP6 will be reported for both scientific and technological aspects.

Keywords: global warming, risk information, numerical simulation, impact assessment, adaptation, mitigation

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U05-03 Room:103 Time:May 25 10:05-10:25

Mapping of interconnection of climate risks

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Anthropogenic climate change possibly causes various impacts on human society and ecosystem. Here, we call possible damages or benefits caused by the future climate change as ”climate risks”. Many climate risks are closely interconnected with each other by direct cause-effect relationship. In this study, the major climate risks are comprehensively summarized based on the survey of studies in the literature using IPCC AR5 etc, and their cause-effect relationship are visualized by a ”network diagram” technique. This research is conducted by the collaboration between the experts of various fields, such as water, energy, agriculture, health, society, and eco-system under the project called ICA-RUS (Integrated Climate Assessment ? Risks, Uncertainties and Society [1]).

First, the climate risks are classified into 9 categories (water, energy, food, health, disaster, industry, society, ecosystem, and tipping elements). Second, researchers of these fields in our project survey the research articles, and pick up items of climate risks, and possible cause-effect relationship between the risk items. A long list of the climate risks is summarized into ˜130, and that of possible cause-effect relationship between the risk items is summarized into ˜300, because the network diagram would be illegible if the number of the risk items and cause-effect relationship is too large. Here, we only consider the risks that could occur if climate mitigation policies are not conducted. Finally, the chain of climate risks is visualized by creating a network diagram based on a network graph theory (Fruchtman & Reingold algorithm).

Through the analysis of the network diagram, we find that climate risks at various sectors are closely related. For example, the decrease in the precipitation under the global climate change possibly causes the decrease in river runoff and the decrease in soil moisture, which causes the changes in crop production. The changes in crop production can have an impact on society by changing the food price or food supply. Changes in river runoff can also make an impact on the hydropower efficiency. Comprehensive pictures of climate risks and their interconnections are clearly shown in a straightforward manner by the network diagram. We will have a discussion how our results can be helpful for our society to recognize the climate risk.

[1] http://www.nies.go.jp/ica-rus/en/index.html

Keywords: climate change, risk management, multi-sector, impact assessment

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U05-04 Room:103 Time:May 25 10:25-10:45

The importance of monitoring the interactions between ecosystem and climate as a key activity in the Future Earth

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A **dynamic equilibrium** of the global climate system is maintained by its interactions with marine and terrestrial ecosystems. An evidence was obtained from a tower-observational study in a larch forest in the eastern Siberia, showing that the consistent vapor supply from the forest even in dry summers supported a humid climate contributing to the own succession. Climate warming with the permafrost thawing due to the human activities, however, may cause a shifting of the dynamic equilibrium between the forest and climate. The larch forest is also an irreplaceable biological resource, and the harvesting may also give unpredictable influences on the shifting.

Therefore, scientific findings on natural processes are closely linked with both policies of environment and biological resources, and it is particularly important that the national policy should comprehensively face this linking. The history of tower-flux observations is very short, only about 10 years, and **'monitoring on the interactions between ecosystem and climate'** based on it should continue for additional 50 years and more on an organizational basis.

However, it may be **not fundamenta**l that a new budget would be allocated to the flux monitoring in addition to the existing organized observations on meteorology, river flow, satellite, and so on. We must **not aim at winning funding competitions**, but our *Future Earth*, promoting *transdisciplinary*, should comprehensively **reorganize the observation systems on Biosphere** in response to the changing relationships of our human society to the global environment called as the *Anthoropocene*.

Keywords: Future Earth, Interactions between ecosystem and climate, Tower flux observation, Policy on biological resources, Larch forest in the eastern Siberia, Continuous fiield monitoring

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U05-05 Room:103 Time:May 25 11:00-11:25

Future Earth and Seismology

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Future Earth is an international and collaborate research program toward sustainable Earth environment. Here I will compare it with seismology and discuss their roles for the society. The most important feature of the Future Earth program is to promote collaboration with various stakeholders beyond academia in order to understand the environmental changes with natural and anthropogenic origins, to provide knowledge necessary for global developments, and to transform towards sustainable societies. The Japan's roles is expected in Asia, which has the largest population in the world and where the environmental and societal changes are rapidly happening.

For the environmental changes in Asia, natural hazards, both meteorological and geological, cannot be neglected. The 2004 Indian Ocean tsunami, caused by the Sumatra-Andaman earthquake (M 9.1), resulted about 230,000 casualties in more than ten countries around the Indian Ocean. The disaster was attributed to the lack of expectation of such a giant (M˜9) earthquake, tsunami warning system, knowledge and preparedness for tsunamis in the governments and citizens. In the last ten years, three regional tsunami warning centers were established in India, Indonesia and Australia, and they issue tsunami warning typically within 5 minutes of large earthquakes. In addition, studies of past tsunami deposits have indicated that a tsunami similar to the 2004 event occurred several hundred years ago. Environmental changes such as global warning or sea level changes are slow and long-lasting, while changes due to hazards are more rapid and shot-term. Although different approaches seem to have been taken for these changes, future potential natural hazards must be considered for sustainable developments, hence long-term forecast of earthquakes and tsunami would be important.

After the 2011 Tohoku earthquake, the Seismological Society of Japan has formed a special committee, held several symposia, and published monographs. The main discussion points are why the 2011 Tohoku earthquake could not be forecasted, how the Society should be involved in national policies, what was lacking for disaster prevention, and how to transfer seismological knowledge in schools or media. A claim has been made that earthquake forecast is a trans-science issue, which cannot be answered by science. A new national project "Earthquake and Volcano Hazards and Observation Research Program" started in 2014, based on an official proposal to the government, emphasizes multi-disciplinary and inter-disciplinary researches and invited researchers from various disciplines such as history or archaeology.

Again, the unique aspect of Future Earth program is an inter-disciplinary research with natural, social, engineering and human sciences, and trans-disciplinary approaches involving various stakeholders beyond academia. It was proposed to co-design the research project and co-produce the results with society. Such interactions with society are common with seismology.

Keywords: Future Earth, seismology, relation with society, inter-disciplinarity, trans-disciplinarity

Japan Geoscience Union Meeting 2015
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U05-06 Room:103 Time:May 25 11:25-11:45

Future Earth and Volcanology

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We cannot avoid meeting natural hazards as far as we live in dynamically moving terrain like Japan Islands. How to maintain our safe lives and peaceful society in coexistence with natural hazards, depends largely on Earth Science's development and its contribution to society. Forecasting the future natural hazards is fate of Earth Science.

Understanding natural hazards does not lead directly to minimizing damages from natural disasters. The worse example was the eruption at Ontake volcano on September 27, 2014. Irrespective of its small scale, it resulted in large damages under the worst scenario. Even if monitoring instrument had been set densely near the crater, it would be impossible to forecast the event like that in Ontake. However, we should interdisciplinally challenge to forecast less-frequent large-scale natural hazards, including understanding their generation mechanisms. Eruption of Mount Fuji and caldera-forming eruptions are the latter examples.

Irrespective of its occurrence frequency, great losses would be induced from natural hazards in the worst case. Most important is preparedness for disasters by people who live in the possible areas, paying their attentions to the future disasters. Earth Science can give them wisdom for the preparedness from various points. It becomes possible even by providing our present knowledge to society. Our advanced understanding of natural hazards with new scientific observations will increase the opportunity where society can be escaped from the future natural disasters, if it is informed effectively to society.

Experiencing the Ontake volcanic disaster, the Volcanic Disaster Committee of the Volcanological Society of Japan inspected the related volcanological issues, and discussed with members about how to contribute for minimizing the future risks from the future similar hazards. In relation to re-opening of the nuclear power plants in Japan, new committee on the nuclear power issue was established within the VSJ, which officially commented on less-frequent large-scale eruptions in the volcanological points of view. VSJ supported the activity of Geoparks, which has the same concept with Future Earth, through the members' contribution in Geoparks. Thus, the aim of Future Earth is compatible with VSJ, where the trans-disciplinal issues are solved together with society.

Keywords: Future Earth, volcanology, relation with society, interdisciplinarity, transdisciplinarity

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U05-07 Room:103 Time:May 25 11:45-12:05

iLEAPS studies on hydrologic - biogeochemical cycles under the Future Earth initiative

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The iLEAPS (integrated Land Ecosystem - Atmosphere Processes Study), a core project of the IGBP (International Geosphere - Biosphere Programme), focuses on the interdisciplinary science of hydrologic - biogeochemical processes that link land - atmosphere exchange, climate, and tropospheric chemistry. Eight initiatives in the iLEAPS are 1) aerosols, clouds, precipitation and climate (ACPC), 2) climatic impacts of adaptation measures, 3) biosphere - atmosphere - society index, 4) emission, exchange, and processes of reactive compounds, 5) extreme events and environments (EEE), 6) bridging the gap between iLEAPS and GEWEX (Global Energy and Water Cycle Experiment) land - surface modelling, 7) interdisciplinary biomass burning initiative (IBBI), and 8) interactions among managed ecosystems, climate, and societies (IMECS). Indeed, humans modify the land surface in many ways that influence the fluxes of water, energy, and trace gases between land and the atmosphere. Their emissions change the chemical composition of the atmosphere and anthropogenic aerosols change the radiative balance of the globe directly by scattering sunlight back to space and indirectly by changing the properties of clouds. Feedback loops among all these processes, land, atmosphere, hydrologic, and biogeochemical cycles extend the human influence. Thus iLEAPS activities will strongly relate to the Future Earth initiatives. In this presentation we will introduce several iLEAPS activities and discuss on how the iLEAPS collaborate with the other Future Earth activities.

Keywords: climate and society, terrestrial ecosystem, land - atmosphere processes, hydrologic cycle, biogeochemical cycle

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U05-08 Room:103 Time:May 25 12:05-12:20

Effective methods against natural shock-wave disasters and their hot evaporated gases

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All natural huge disasters of earthquake, volcano and asteroid-impact which are caused by shock-waves of extreme states more than rapid sound-wave (Miura, 1996), change continuously the Earth system and life substances for 4.6 billion years to be formed present images of different broken sites and multi-kinds of living entity. In active planet Earth with complicated systems, expected strategy for disaster risk reduction and resilience are summarized for as follows:

1) We cannot stop artificially any natural disasters of earthquake and volcano with rapid shock-waves on active Earth, whereas any underground changes after the shock-waves with larger natural disasters can be observed to be developed by in-situ observation and data-accumulation. However, asteroid impacts can be tracked and controlled by the extraterrestrial orbits before the shocked collisions to our Earth. We can avoid Asteroid collisions with higher costs and technological long-term projects surely, which will be equivalent to plan with huge expenses to be protected human extinction in future.

2) Present Earth combined with different blocks and many living substances with different locations have been changed abruptly with one developed direction by strong natural disasters related with shock-wave processes (including asteroids impacts caused to any mass extinction at the previous geological boundaries).

3) We can develop continuously disaster-resilience due to less prevention against larger-scale natural disasters caused by shock-waves. In this sense, any strategy, expenses and emigration are expected to be planned deeply. For example, we should make progressive plans to use effectively less volcanic areas (cf. western main-island etc.).

4) Compared any larger natural disasters on active Earth, any asteroid-collisions can be controlled by extraterrestrial tracking- and attacking- stations in other celestial bodies before the entry to the air or surface.

5) The effective reduction strategy of global climate-warming caused by industry-related high temperature gases of carbon dioxides should be applied globally by continuous changes without any stopped disposal plans, which are considered to be similar significant developments without any stopped disposals (Miura, 2013, 2014, 2015) in active planet and human life effectively.

References: Miura Y.(1996): Shock wave handbook (Springer). p.1073-1209. Miura Y. (2013): Japanese Patent. Miura Y. (2014). Am. Chem. Soc. , 248th, p.19675. 72. Miura Y. (2015):Tokyo Conference on International Study for Disaster Risk Reduction and Resilience (Univ. Tokyo),No.17.

Keywords: Shock wave, Disaster, Effective methods, Volcano, Hot carbon dioxides, Meteoritic collisions

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U05-09 Room:103 Time:May 25 12:20-12:45

Land use scenarios: An analysis of urban resilience

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Increase of natural hazard risks is projected in the global scale, and it is getting more and more important to adapt and mitigate natural hazard risks in multiple spatial scales, including global, national, and regional/urban scales. This study discusses adaptation and mitigation to natural hazard risks in an urban scale. Specifically, we focus on a mitigation policy, which reduces CO2 emissions by urban compaction, and an adaptation policy, which reduces flood hazard risks by moving people living in flood prone areas to safer areas. Impacts of these policies are analyzed using the landuse-transportation-energy model, which is an economic equilibrium model. The target area is the Tokyo metropolitan area. The result suggests the importance of applying both of these policies for effective reduction of natural hazard risks. Besides, influence of these policies on resulting urban form is also analyzed. Based on these results, it is discussed how to increase urban resilience.

Keywords: urban resilience, land use scenario, socioeconomic scenario, hazard risks

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U05-10 Room:103 Time:May 25 14:15-14:40

Optimal governance for water-energy-food nexus in Asia-Pacific region

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Climate change and economic development are causing increased pressure on water, energy and food resources, presenting communities with increased levels of tradeoffs and potential conflicts among these resources. Therefore, the water-energy-food nexus is one of the most important and fundamental global environmental issues facing the world. As water is the central matter within this cluster, we will focus on the inherent tradeoffs between water and food, and water and energy. For the purposes of this project, we define human-environmental security as the joint optimization between human and environmental security as well as the water-energy and water-food connections. To optimize governance and management within these inter-connected needs, it is desirable to increase human-environmental security by improving social management for the water-energy-food nexus. In this research project, we intend to establish a method to manage and optimize the human-environmental security of the water-energy-food nexus. We base our approach on the viewpoint that it is important for a sustainable society to increase human-environmental security and decrease vulnerability by optimizing the connections within the critical water-energy and water-food clusters.

As the interim results of the project, we have evaluated the potential ground heat storage, geothermal energy, micro-hydro power in Japan and Philippines as the capacities for the tradeoff and the potential conflicts between water and energy. Relationships between fishery production and fishery diversity, between diversity of the water discharged from land to the ocean and fishery production/diversity, water as well as connectivity between land and ocean as the resilience to the risks such as tsunami, and social demographic change such as decreasing labors and increasing demand of energy.

Stakeholder analysis and social network analysis have been made to analyze the common interests/disputes among water-energy-food nexus and stakeholder behavior changes by using local stakeholder meetings as co-design and national level discussion on web about water-energy food nexus such as geothermal energy development and hot spring preservation. Framing of the integrated index, integrated maps, integrated physical models including water, nutrients, and biomass/fishery production have been also making for helping optimal policy selections. Integration of the local-national scale of the stakeholders have been also making based on involvements of new water act in Japan and California sustainable groundwater act as well as participatory web as co-monitoring of local environments such as natural springs. Linkage to the global nexus platform has been also made to Bonn Nexus, North Caronia Nexus, World Water Week, and others.

Keywords: water, energy, food, nexus, governance, Asia Pacific

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U05-11 Room:103 Time:May 25 14:40-15:00

Global and regional integration of social-ecological study toward sustainable use of biodiversity and ecosystem services

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The expanding global economy has accelerated losses of biodiversity and multiple ecosystem services through global climate changes and rapid land/sea use changes, which are especially pronounced in Asia. Establishing sustainable use of biodiversity and ecosystem services is highly needed though activities like environmental stewardship cultivated through co-design, co-production and co-management activities at both local and global scales. However, scientific knowledge is still limited to plan and execute effective management activities at these respective scales with the presence of bottlenecks such as the lack of fine-resolution information of the distribution of biodiversity, the high degree of variability in biodiversity and ecosystem services across multiple environmental gradients, insufficient understanding of the importance of interconnectivity among different ecosystem types (e.g., terrestrial-coastal interactions), lack of scientific knowledge within local communities about the status of biodiversity and ecosystem services, and due to insufficient communication among stakeholders and local citizens with different interests and demands.

A transdisciplinary project on ”Belmont Forum Collaborative Research Action on Scenarios of Biodiversity and Ecosystem Services” has started since April 2015 (for the period of 2 years) by a group of international scientists. The project, entitled as TSUNAGARI (Trans-System, UNified Approach for Global And Regional Integration of social-ecological study toward sustainable use of biodiversity and ecosystem services) aims to build a network of researchers to address the above-mentioned problems of decision-making processes for the sustainable use of biodiversity and multiple ecosystem services in Asia. The project consists of the following 4 main objectives; (1) Establishing methodologies to integrate fine-resolution spatial information of ecosystems to a broad-scale database for the improvement of precise evaluation of biodiversity and multiple ecosystem services. (2) Examining and understanding scale-dependency in the effects of multiple human-induced drivers on variability in biodiversity and multiple ecosystem services, and in the decision-making processes of biodiversity and multiple ecosystem services use by societies at various levels. (3) Evaluating the importance of ecosystem connectivity (from forest to marine ecosystems) on the variability and changes in biodiversity and multiple ecosystem services, and investigating how connectivity affects the interactions among local communities at different sites within a watershed, and on their decision-making. (4) Developing new indicators and models for scenario analysis to achieve sustainable biodiversity and multiple ecosystem services use based on feedbacks between ecological and socioeconomic sciences using outputs of above-mentioned objectives.

By overcoming the major bottlenecks in biodiversity and ecosystem services research and in their management, the outcome of this project will contribute significantly to conservation and sustainable management in Asia-Pacific regions, both for academic societies and for practitioners to advance their decision-making processes at multiple levels (from local community to international levels).

Keywords: Ecosystem connectivity, Scenario analyses, Biodiversity footprint, Co-management, Land-use change, Multi-spatial scale interactions

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U05-12 Room:103 Time:May 25 15:00-15:25

Creation of Trans-disciplinary Research on Resilience of Mongolia in Rapid Development

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Mongolia faces a rapid urbanization as well as land development in the last few years, although its measures for disasters and environmental management are far behind. In addition, the nomadic lifestyle as well as the social structure have changed dramatically as liberalization progressed, and the society is gradually losing its resilience (or flexibility and adaptability) to disasters and social change. Therefore, time demands for reconsideration of traditional resilience as well as determining a long term vision for the future of Mongolia, which takes into account the detailed hazard evaluation. In 2014, Nagoya University and National University of Mongolia launched together the Project Office for the Resilience Research Center in Ulaanbaatar and held the first ”Pre-Open Symposium” on September 15.

In this Center, we first attempt to introduce a variety of research findings: geographical research of active faults and cases of severe winter that causes deaths of large number of livestock due to starvation and/or the cold (so-called ”dzud”), anthropological research on changes in traditional culture and social structure, and environmental research such as atmospheric pollution. We showcase these findings at regular seminars for students and the public of Mongolia in an attempt to provide them with insights for discussion of resilience. We encourage participation of students in our research projects so that they will be trained to find out solutions for the way in which the resilience of Mongolia should be. The key topics for the seminars include (1) urban planning, in consideration of the measures for hazards, (2) redevelopment of the ”ger area” in Ulaanbaatar, and (3) an expansion plan of the metropolitan area.

In addition, this research will contribute to the research agenda C: Transformations towards Sustainability in Strategic Research Agenda 2014 of the Future Earth, in particular, C3: Transforming development pathways and C3-2: What are the potentials and possibilities for adapting and transforming infrastructure and services in urban and rural areas, in diverse socio-economic contexts, given the constraints and interdependence of these systems? What types of running processes and tools can contribute to integrated urban and rural sustainable development?

Keywords: resilience, disaster, Mongolia, Trans-disciplinary Research

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U05-13 Room:103 Time:May 25 15:25-15:40

Sustainability of the Great Chain of Being

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TBD

Japan Geoscience Union Meeting 2015
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U05-14 Room:103 Time:May 25 15:40-16:00

A spatial hedonic analysis of trade-offs between benefits and hazard risks

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In Japan, which suffered a serious Tsunami damage in the 2011 Great Eastern Japan Earthquake, it is an urgent task to increase resilience of bayside areas, which are typically in flood prone areas. However, in bayside areas, their attractiveness (e.g., their own scenic ocean views and other factors from oceans) is likely to be emphasized, and their flood risks might not be perceived as negative factors appropriately. Thus, this study performs a spatial hedonic analysis in Yokohama city, and quantifies influences of both positive factors from the ocean (e.g., ocean view and access to the ocean) and flood risks. The result reveals that, while ocean view and access to the ocean have significant positive influences as expected, any significant influence is found from flood risks. Also, joint influence of these variables shows that, in Yokohama, bayside flood prone areas are as perceived as attractive areas; in other words, flood risks are not perceived as negative factors appropriately. Based on these results, we discuss possible urban policies to decrease flood hazard risks while holding attractiveness of bayside areas.

Keywords: flood hazard, view, hedonic analysis, Yokohama city, remote sensing

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U05-15 Room:103 Time:May 25 16:15-16:35

Digital Earth as a Platform for Synthesis of Knowledge Towards Resilient and Sustainable Society

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The Digital Earth (DE) is a virtual representation of our planet on the internet, and enables a person to explore and interact with the vast amounts of natural, socio-economic and cultural information gathered about the earth. DE is designed as a multi-dimensional, multi-scale, multi-temporal, and multi-layer information facility. As Digital Earth 2020 Vision, DE should be a dynamic framework to share interoperable information and improve collective understanding of the complex relationships between society and the environment. DE should make it possible to navigate across space and time, connecting the global issues to local ones. DE should include scientific models to project into the future and helps us all understand how the Earth system works and what are the likely consequences of our actions or inactions.

DE should firstly is employed for the ESD (Education for Sustainable Development). ESD is an indispensable element for achieving sustainable development vision and participatory teaching and learning methods that motivate and empower learners to change their behavior and take action for sustainable development. To try to find solutions to problematique in practice, ESD promotes competencies and essential skills like holistic views, critical thinking, systemic thinking, imagining future scenarios and making decisions in a collaborative way. The DE can also facilitate data-intensive studies for problematiques of the 21st century as well as the above ways. We realize Digital Earth and geospatial information technologies are indispensable tool for ESD. This presentation introduces some exploratory research projects and examines how Digital Earth can help making our society Disaster Resilient and Sustainable as a use case. We propose Digital Earth platform as a public information base which has cloud-based geospatial information system and services in cooperation with multi stakeholder

Keywords: Digital Earth, Synthesis of Knowledge, Education of Sustainable Development, Collective Knowledge, GIS, Future Earth

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U05-16 Room:103 Time:May 25 16:35-16:55

Future Earth and Land Use

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Land use study is widely and deeply related with diverse range of missions of Future Earth. In another words, its success is vitally important for the success of Future Earth, which is a new international framework of global change research. However, land use, which can be seen as a reflection of society, nature and their interaction on the land, is difficult to grasp without truly integrative and historical views. The present paper discusses priority themes and desirable directions of land use studies under the framework of Future Earth.

Keywords: Future Earth, land use, global change research

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Earth system literacy for citizens

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In order to solve environmental problems, such as climate change and decline of biodiversity, understanding mechanisms of the Earth system is critical. Not only specialists study those mechanisms but also policy makers and general public should know some basics and fundamentals of the Earth system that allow them to choose policies properly. But, what level do they need to understand the relevant science? We, Miraikan, aiming to realize a sustainable future society with 10 billion people, are conducting science communication activities that include a research for Earth system literacy for citizens and a dissemination of the literacy via permanent exhibits.

One of the most important issues from science communication point of view is the carbon cycle in ecosystem. It is rather well known that creatures are mutually connected with each other in the complex food web. However, more importantly, the carbon cycle needs to be understood at the atomic level for understanding the Earth environmental issues, such as the global warming. What causes the environmental problems we are facing can be defined in the following three major “bad behavior“ by humans. Those are; 1. Disrupting connections among life forms, 2. Disturbing amounts of cycling materials, 3. Making only one direction flow. Various phenomena related to the Earth environmental problems and measures for solving the problems should be evaluated from the “bad behavior“ point of view.

Another important science communication activity is to grasp the actual scales of human activities concerned with the three “bad behavior“. Human activities can be found everywhere on Earth and directly observed from remote sensing satellites. At Miraikan, we exhibit data that visualize those human activities.

Keywords: Earth System, Carbon Cycle, Remote Sensing

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Issues and Perspectives of Human Resources Development in Future Earth -Use of Environmental Leaders Network-

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The human resources development is one of the most important issues in the Future Earth. The International Environment Leaders Training Program launched in 2008 by MEXT and run by 17 universities has completed in the end of 2014 FY, and it has produced approximately 1300 Environmental Leaders in total. The program has aimed to establish centers or systems to foster environment leaders, who will take the leadership to solve the environmental problems in developing countries. The major of the Environmental Leaders fostered by 17 universities covers a variety of field in the environmental issues, low carbon technology, integrated watershed management, adaptation to climate change, resilience of environment, water resources, energy, comprehensive wisdom, leadership, and so on. The home countries of the environmental leaders are approximately 80 such as China, Vietnam, Indonesia, Bangladesh, Japan, etc. We need to use the talents and network of the Environmental Leaders for Future Earth, considering the diversity of the capacity and the region. We will present cases of the missions and education contents of the Environmental Leaders to discuss the issues and perspectives of human resources development in the Future Earth.

Keywords: Environmental Leader, Global Leader, human resources development, human resources network