Introduction of the Research Projects

C Circulation

Program Director ■ **HAYASAKA Tadahiro** RIHN

What is circulation in relation to global environmental problems? Two concepts of circulation are considered in this program. One is circulation of energy and matter at the Earth's surface. The word matter includes atmosphere and ocean themselves, and chemical components and living organisms therein. In the broader view, it is applied to human being and goods in socio-economic activities. Solar radiative energy absorbed by the Earth's surface systems as well as fossil fuel causes the circulation of energy and matter in various forms. The circulation in a large spatial and temporal scale may look like a flow in a small scale. The critical issue in the global environmental problems is sudden and irreversible change in the circulation, which is hard to predict in the future. It is closely related to culture, thought, and action in the human society.

Another way to grapes circulation here is a more conceptual view. In the framework of humanity and nature, the interaction between them can be considered a kind of circulation in a different dimension from the circulation of energy and matter at the Earth's surface. The development of economy, industry and technology gives rise to huge energy consumption and changes in landuse. The circulation in the sense of interaction is the process in which human society influences nature, altered nature in turn influences human society and human society then again influences nature. The fact that human society changes in this process means that the interaction of human being and nature is not simple one.

The individual research project in the circulation program is carried out with the above concepts, and the outcomes from the research project will be sent out together from RIHN.

Completed Research	Leader	Theme
C-01 (CR2)	HAYASAKA Tadahiro	Emissions of Greenhouse Gases and Aerosols, and Human Activities in East Asia
C-02 (CR2)	KANAE Shinjiro	Global Water Cycle Variation and the Current World Water Resources Issues and Their Perspectives
C-03 (CR1)	FUKUSHIMA Yoshihiro	Recent Rapid Change of Water Circulation in the Yellow River and Its Effects on Environment
Full Research	**Leader**	**Theme**
C-04 (FR4)	SHIRAIWA Takayuki	Human Activities in Northeastern Asia and Their Impact on the Biological Productivity in North Pacific Ocean
C-05 (FR3)	TANIGUCHI Makoto	Human Impacts on Urban Subsurface Environments
C-06 (FR2)	KAWABATA Zen'ichiro	Effects of environmental change on the interactions between pathogens and humans
Pre-Research	**Leader**	**Theme**
C-07 (PR)	INOUE Gen	Global Warming and the Human-Nature dimention in Siberia —The social adaptation to the changes of the terrestrial ecosystem with an emphasis on the water environment
Feasibility Study	**Principal Investigator**	**Theme**
C-FS1	MURAMATSU Shin	Urban Circularity and Diversity: Future Possibilities for a Great Complex System to Bridge the Human Race and Global Environment
C-FS2	NAKANO Takanori	Study of regional diversity of water quality: toward water management based on circulation

Project Homepage ● http://www.chikyu.ac.jp/Project2-1/

Emissions of Greenhouse Gases and Aerosols, and Human Activities in East Asia

The recent growth of economy in East Asian region is being watched with keen interest. The relationship between human activities and emissions of greenhouse gases and aerosols in this region are studied with collaboration of socioeconomic analysts and atmospheric scientists. This research project consists of macro-analysis of economy, development of emission inventory, analysis of atmospheric transport by using model and satellite data, and ground-based observation around Japan and China.

Project Leader ■ **HAYASAKA Tadahiro** RIHN

The present study focused on the East Asia, especially China for the past few decades to investigate (1) relationship between the change in human activities such as economy and industry and the change in emissions of a anthropogenic gasses and aerosols, and (2) the influence of the emitted gases and aerosols on the climate change and air pollution.

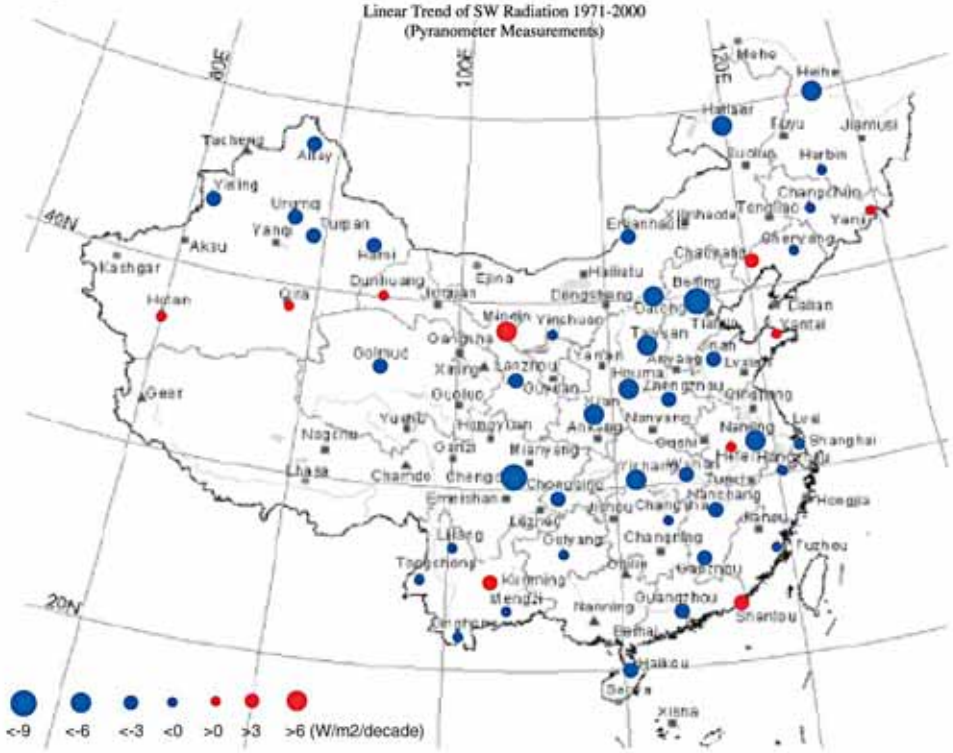
The macroanalysis of economy was performed as planned. The economic development in the East Asian countries led by the industrialization brought increases in energy consumption and emissions of CO_2, SO_2 and others. However, SO_2 emission has not increased so much as expected. The emission density of CO_2 has not increased or has decreased due to an improvement of energy efficiency.

The emission inventory was developed according to the initial plan, which includes anthropogenic greenhouse gases, aerosols, and precursors of aerosols for the period, 1980-2003. **Figure 1**, for example, shows the changes in the amount of the emission of SO_2, NO_x, and Black carbon (BC) in Asia.

The analysis of emitted anthropogenic gases and aerosols was performed with observations and atmospheric transport models. The observations of greenhouse gases were carried out in China and around Japan. The observations of aerosols were carried out mainly in Japan. The results of those observations were consistent with the emission inventory.

As a result, aerosol loading increased with an increase in fossil fuel consumption in China and other Asian countries and air pollution increased, and thus surface shortwave irradiance decreased. However, the surface air temperature increased in almost all regions of China for the past 40 years, because of increasing greenhouse gases and complicated climate system.

Figure 1 Linear trend of surface shortwave irradiance observed in China for 1971-2000.



C-02 (CR2)

Circulation

Global Water Cycle Variation and the Current World Water Resources Issues and Their Perspectives

It is alleged that the 21st century is the "century of water." Wars over water may occur, like those fought over oil in the last century. The rapid increase in population and the coming global climate change could cause water scarcity. This project attempts to develop global perspectives of such water resource issues by integrating field observations, predicting natural water cycles and human water usage in the future, and by establishing guidelines for sustainable development from the viewpoint of water resource issues.

Project Leader ■ **KANAE Shinjiro** Institute of Industrial Science, the Univiersity of Tokyo (RIHN until March 2007)

Specific Research Findings

Regarding the primary goal, which is, "showing perspectives and making projections", we have succeeded in positioning our research on the cutting-edge, with the finest estimation and projection of global water cycles and resources in the world. For example, we successfully reproduced the daily fluctuation of land hydrological cycles through the past 100 years for the first time in the world. At the same time, we made a projection of land hydrological cycles for the next 100 years. Moreover, by estimating current and future water demands through an integration of all the estimations above, we have calculated current and future water stress on a global scale.

Contribution to "Earth-Environment Study"

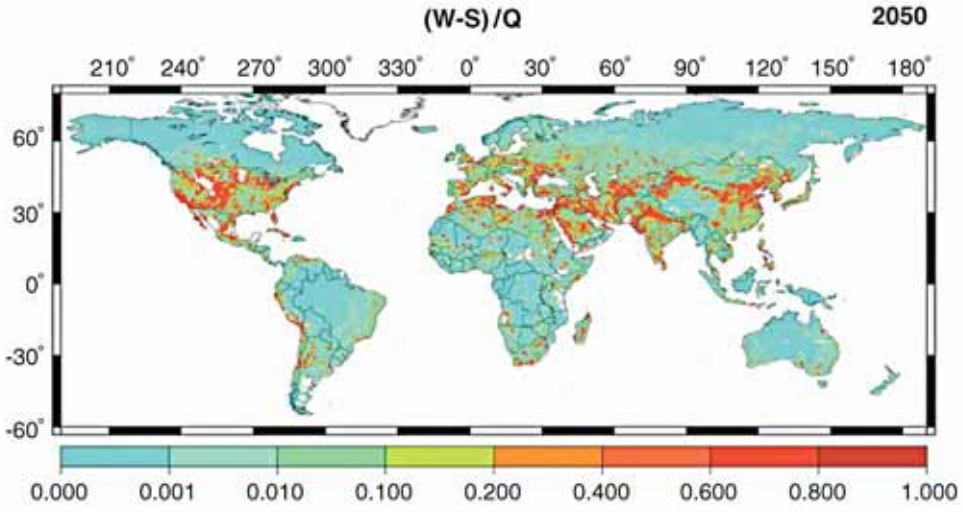
We have succeeded in making an estimation and projection of global water cycles and resources paying attention to the interaction between humans and nature. It is, however, on a local scale that such an interaction is considered in the study of water circulation and water budgets. This interaction, especially on a global scale, has been overlooked. In this sense, our results can be a model of "Earth-Environment Study." Besides, we also carried out research that dealt with specific areas with water problems, such as Thailand and California.

Studies that analyzed policy tools for preventing water conflict and water shortage are additional examples of an interdisciplinary analysis.

Communication of Research Findings

Dr. Taikan OKI, the former leader and currently a core project member, was chosen as the lead author of the IPCC AR4 and the Millennium Assessment. Also our paper in Science has effectively promoted the achievement of this project. Moreover, our achievement on virtual water has been widely disseminated in domestic society through multiple media and a "White Book" on water resources made by the Japanese government. We hope our research results (**Figure 1**) become a seed for ideas for coming water-related projects.

Figure Annual Withdrawal to Availability Ratio



The map shows the quotient obtained by dividing (expected water consumption for 2050) by (water availability forecast for 2050) of each geographic area. The quotient is high in areas painted red or yellow, in which available water is expected to be almost used up. In other words, red and yellow areas are candidate water crisis "hot spots."

Project Homepage ● http://www.chikyu.ac.jp/yris/

Recent Rapid Change of Water Circulation in the Yellow River and Its Effects on Environment

The recent crisis that occurred in the Yellow River basin is complicated because factors like natural climate fluctuation, global warming and changes of land utilization may be affecting one another. We will evaluate how land use changes affect the water cycle throughout the Yellow River drainage basin and what kind of effect the decrease in groundwater storage downstream could have on marine conditions, through five years of research. This study may prove to be at the forefront of ecological studies of densely- populated coastal zones, and through studying the Bohai Sea and Yellow Sea.

Project Leader ■ **FUKUSHIMA Yoshihiro** (RIHN until March 2008)

Outcome

By implementing our Yellow River Study Project (hereafter referred to as YRiS), we were able to invite young and excellent researchers from Chinese universities and institutes. We were also able to obtain good results from the exchange of information between Japanese and Chinese scientists, and from our analysis based on observations, investigations and inspections over a period of five years from 2003 to 2007.

We found that reforestation works by the institute for soil and water conservation on Loess Plateau occupying almost 40% of the Yellow River Basin area have resulted in a remarkable decrease in the volume of river water by 15 billion m^3 due to an increase in evapo-transpiration in keeping with successful reforestation since the 1980s. The Chinese Yellow River Conservancy Commission (YRCC) had not been aware that this tremendous decrease in river water was due to the effects of reforestation. However, this amount can be explained by the results of our experimental research which found that the increase in evaporation is less than 50 mm annually. We also found that rules for the supply of water from the Yellow River to each province had already been decided in the 1980s. These rules gave each province independent authority. After the severe drying-up of the Yellow River that occurred in 1997, an improved "water law" was established and it became effective in 2002. Most importantly the Chinese government was given complete authority over river water use and the ability to punish cases where disobedience occurred. Fortunately, there has been a rather large amount of precipitation on the North China Plain since 2000, so there were no instances of the unfair use of river water.

Though the yield of eroded material from the Loess Plateau has gradually decreased, the downstream riverbed is still continuing to increase or to maintain the same level despite the completion of the Xiaolandi Dam in 1997 and its important function of flushing out sediment on the riverbed by instigating small flood events. This means that there is increased danger of a flood disaster in an area in which nearly 100 million people live.

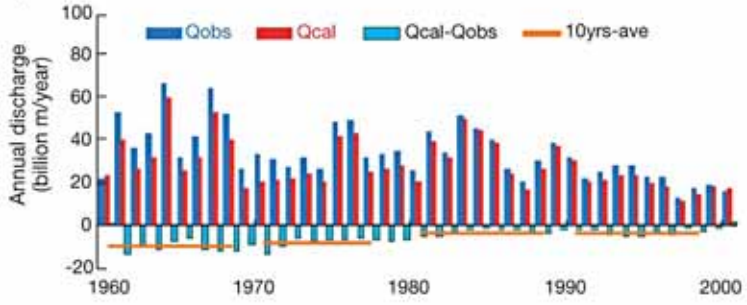
The environment of the Bohai Sea has been changed by the shortage of inflow water from the Yellow River. Firstly, the critical condition for primary bio-production has changed from Nitrogen to Phosphorus. Secondly, the exchange of fresh and sea water has decreased remarkably. Thirdly, chlorophyll-*a* has decreased with the decrease of river water. These findings suggest that primary bio-productivity in the Bohai Sea is decreasing.

How changes in land use have affected the atmosphere above the Loess Plateau is still being analyzed because topographic conditions and the strength of the Asia Monsoon seem to have a larger affect on the atmosphere than conditions on the surface of the land such as whether it is planted in crops or is bare.

Large irrigated districts such as Qintongxia and Hetao, located upstream, are estimated to have consumed the same amount of river water for irrigated agriculture from 1960 to 2000. Their consumption is estimated at almost 10 billion m^3.

You can find accounts of our study in YRiS Newsletters 1-8, published from Sept.1, 2003 to January 31, 2008. (http://www.chikyu.ac.jp/yris/newsletters.html)

Fig. Result of model simulation for the Loess Plateau area



Future Issues

With growth in the human population, irrigated agricultural fields may have to expand into areas where climate conditions are rather dry, in order to obtain more food crops. Nevertheless, efforts to increase the efficiency of water use would appear to be too late to improve agricultural fields given the rather small amounts of precipitation, and salt accumulation is apt to affect even the Yellow River Basin. The supply of water from the Chang Jiang River to Beijing, Tianjin and the North China Plain is to be realized soon. But many problems can be anticipated because the pollution of the Yellow River water remains unresolved. Therefore, the diversion of water may cause increased water pollution in the Bohai Sea.

Human Activities in Northeastern Asia and Their Impact on the Biological Productivity in North Pacific Ocean

Recently, we have recognized a possible function of continental forests breeding fish in ocean. In this study, we will investigate how the Amur River transports dissolved iron from forests to the Sea of Okhotsk and the Oyashio area and supports primary production, and clarify to what extent the human activities on the Amur basin may disturb this material linkage, in order to create an ideal relationship between land and ocean ecosystems including humankind.

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Photo 1 Transportation of Russian timbers (Suifunhe station)

Giant Fish-Breeding Forest Hypothesis

Background

Japan has developed a concept called "Uotsukirin (fish breeding forest)" that implies a system connecting the land surface with the ocean in terms of ecological linkage. We are proposing a similar but much larger-scale concept we have called "Kyodai Uotsukirin ("Giant" Fish-breeding forest)" to show the ecological linkage between the Amur river basin and the Sea of Okhotsk/Oyashio area. The system has various functions, but it is uniquely characterized by the flow of dissolved iron, which is an essential element for the primary production of the Oyashio area. The Amur River basin is underlain by extensive wetland and forest; both are important sources of dissolved iron. The dissolved iron is transported to the Oyashio area through the Sea of Okhotsk by thermohaline circulation driven by sea-ice production in the Sea of Okhotsk. This natural mechanism distributes the dissolved iron further into the Oyashio area with a help of the east Sakhalin current. This well established system tells us that the ecological conditions in the Sea of Okhotsk and the Oyashio area are determined by the land surface condition in the Amur River basin.

The Amur River basin includes territories in Russia, China and Mongolia. More than 100 million people live in the basin and depend on agriculture, forestry and industry for their livelihoods. The human activities impact on the land surface conditions so that the changes in land uses influ-

Figure 1 Land use pattern of the Amur River basin (left:1930s'-1940s', right:2000)

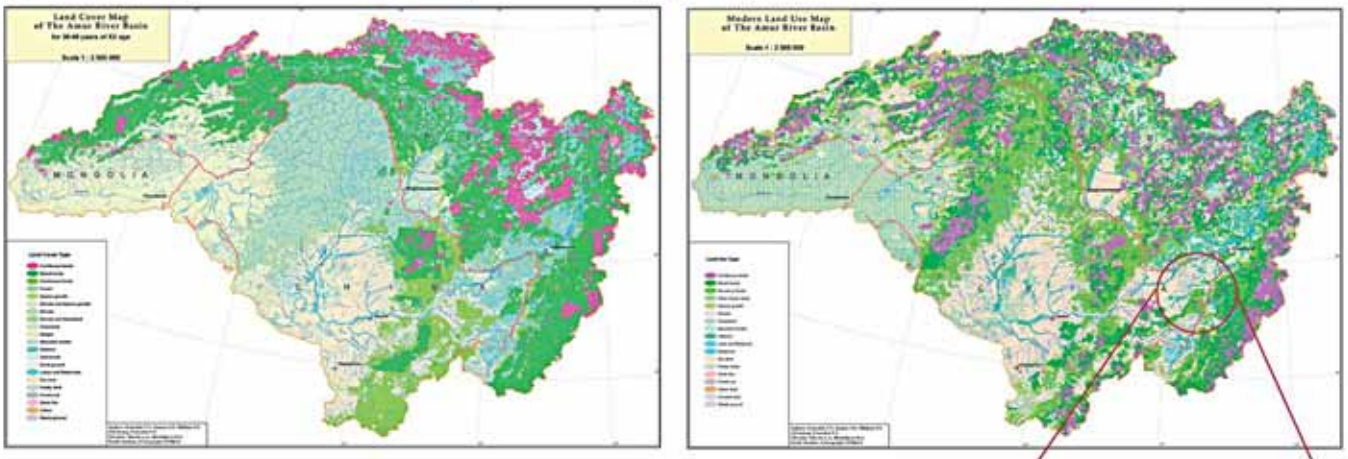
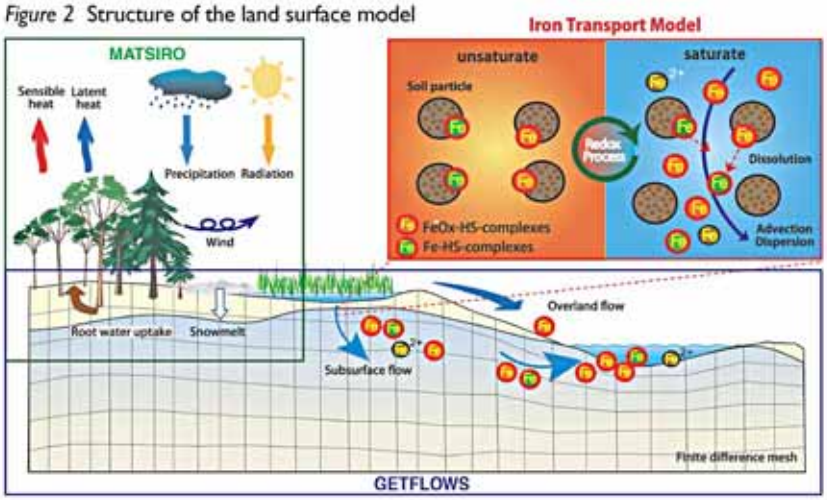
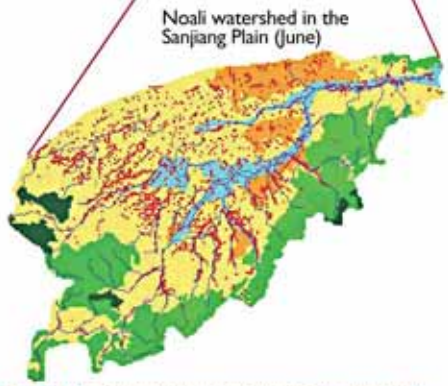


Figure 2 Structure of the land surface model





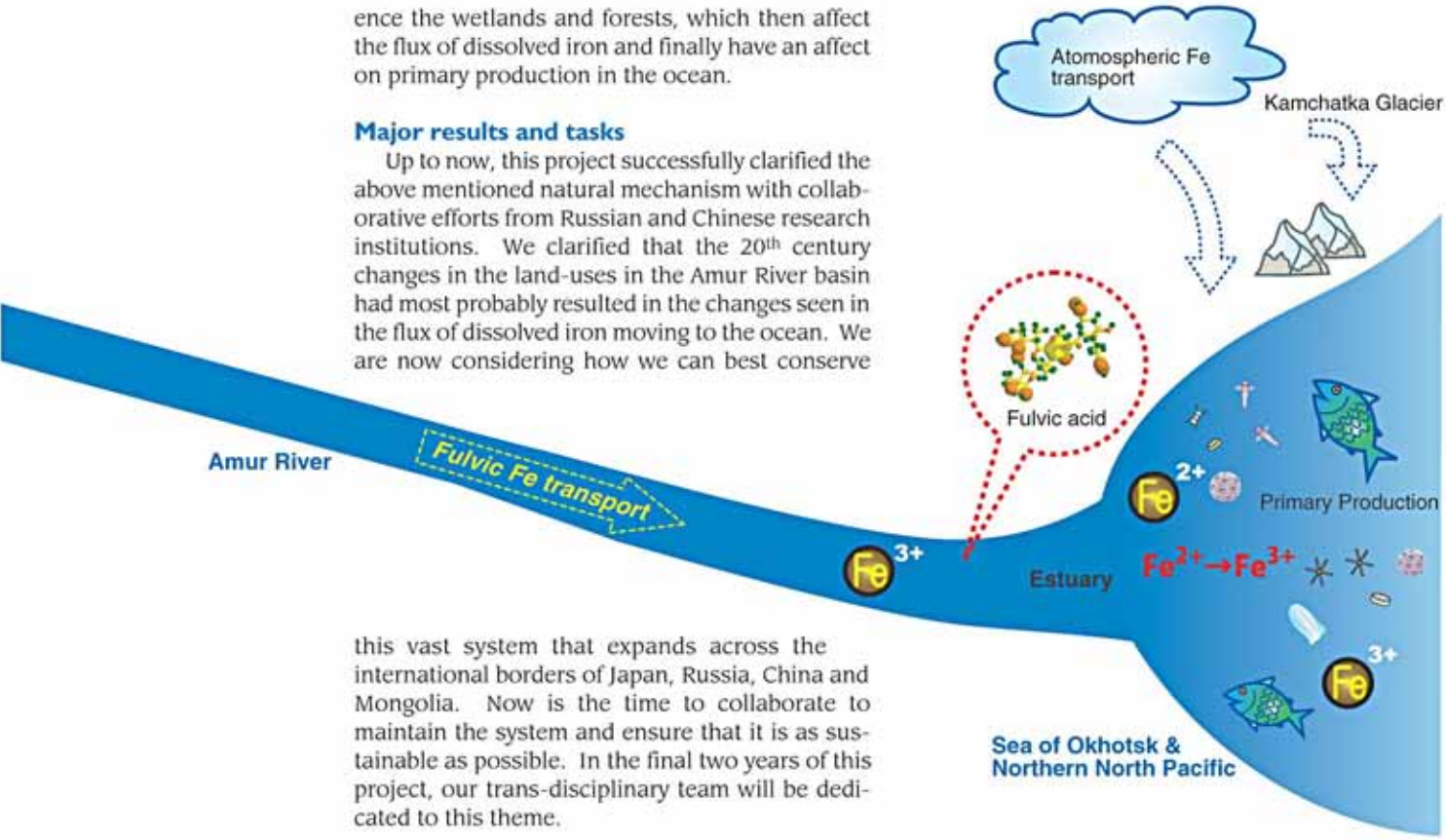
■ : The location where dissolved iron is produced
Dissolved iron concentration is calculated according to the degree of soil saturation

Figure 3 Example of simulated dissolved iron distribution

ence the wetlands and forests, which then affect the flux of dissolved iron and finally have an affect on primary production in the ocean.

Major results and tasks

Up to now, this project successfully clarified the above mentioned natural mechanism with collaborative efforts from Russian and Chinese research institutions. We clarified that the 20th century changes in the land-uses in the Amur River basin had most probably resulted in the changes seen in the flux of dissolved iron moving to the ocean. We are now considering how we can best conserve this vast system that expands across the international borders of Japan, Russia, China and Mongolia. Now is the time to collaborate to maintain the system and ensure that it is as sustainable as possible. In the final two years of this project, our trans-disciplinary team will be dedicated to this theme.



Human Impacts on Urban Subsurface Environments

This project will assess the effects of human activities on the urban subsurface environment, an important aspect of human life in the present and future but not yet evaluated. This is especially true in Asian coastal cities where population numbers and density have expanded rapidly and uses of subsurface environment have increased. The primary goal of this project is to evaluate the relationships between the development stage of cities and various subsurface environmental problems, including extreme subsidence, groundwater contamination, and subsurface thermal anomalies. We will address the sustainable use of groundwater and subsurface environments to provide for better future development and human well-being.

Project Leader ■ **TANIGUCHI Makoto** RIHN

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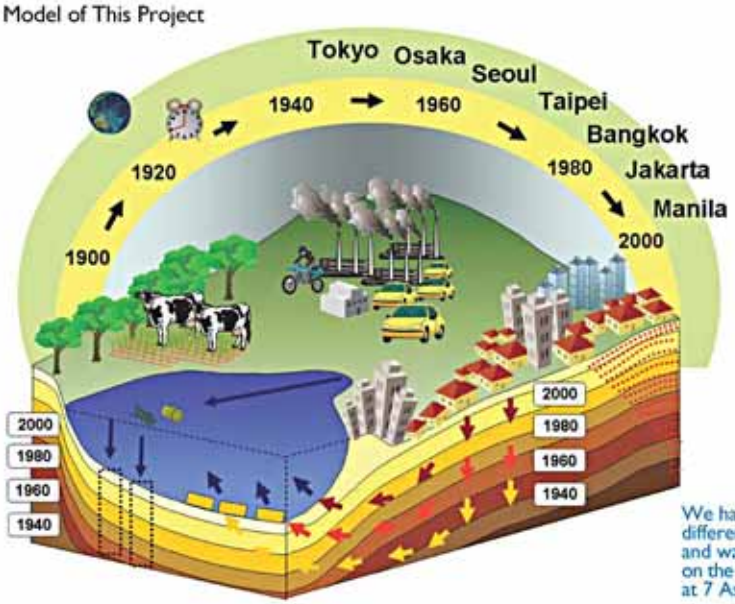
(1) Objectives of this project

Most global environmental studies have long been focused on the environmental issues above ground surface such as air pollution, global warming, seawater pollution, and decrease in biodiversity. Subsurface environmental issues are also important for human life in the present and future, but have been largely ignored because of the invisibility of the phenomena and difficulty of the evaluations. Subsurface environmental problems such as subsidence due to excessive pumping, groundwater contamination, have occurred repeatedly in Asian major cities with a time lag depending on the development stage of urbanization. Therefore, we may be able to assess future scenarios if we can evaluate the relationships between subsurface environmental problems and the development stage of the city.

This project will deal with; (1) Relationships between the development stages of the cities and subsurface environmental problems will be assessed by socio-economical analyses and reconstructions of urban areas by uses of historical records; (2) Serious problems in subsurface environments and changes in reliable water resources will be studied after evaluations of groundwater flow systems and changes in groundwater storage by uses of hydrogeochemical data and in-situ/satellite-GRACE gravity data; (3) We will also evaluate accumulations of the materials (contaminants) in subsurface and their transports from land to ocean including groundwater pathways by uses of chemical analyses of subsurface waters, sediments and tracers; and (4) Subsurface

Figure 1 Schematic Model of This Project

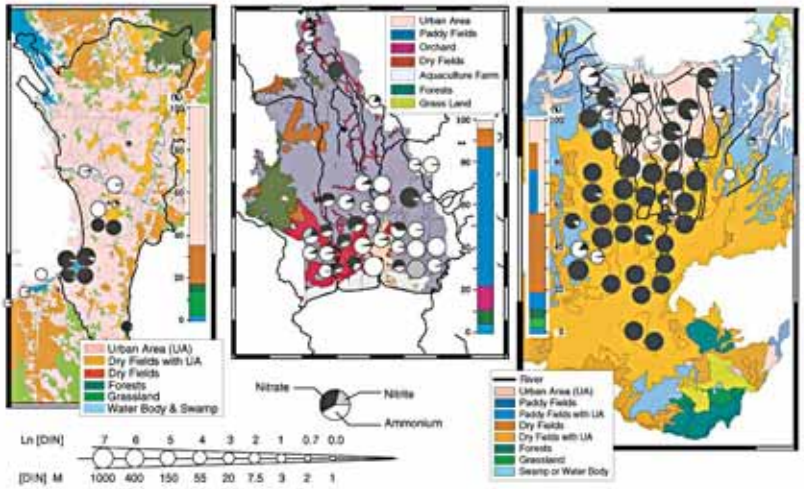


We have investigated how the different developing processes and water usage have affected on the subsurface environments at 7 Asian-Mega cities.

Photo 1 A children drawing well water at Jakarta

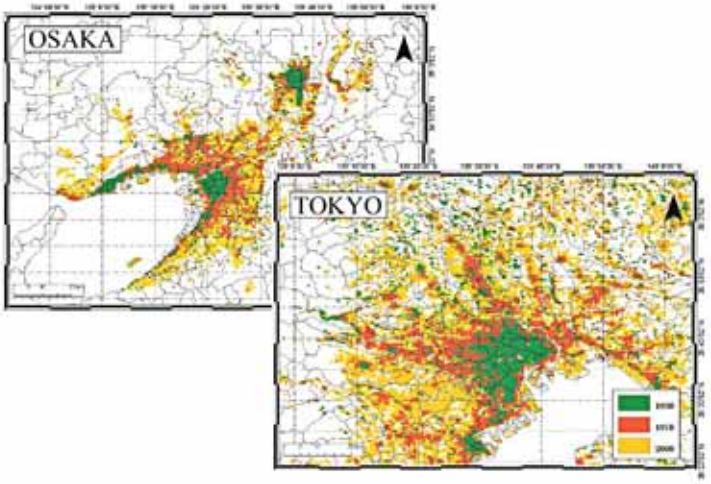
What can we do for conservation and sustainable use of groundwater?

Figure 3 Groundwater pollutions in Asian cities



Magnitudes and composition ratios of Nitrate, Nitrite, and Ammonium pollutions of groundwater at Manila (left), Bangkok (middle), and Jakarta (right).

Figure 2 Expansions of urban area at Tokyo and Osaka from 1930 to 2000



Changes in land cover/use due to urbanization are used for analyses of subsurface environment in Asian cities based on GIS.

thermal contamination due to the "heat island" effect in urban areas will be evaluated by reconstruction of surface temperature history and urban meteorological analyses.

(2) Progress of the project

- Field surveys on subsurface environment in targeted cities have been made (12 times in 2007), and monitoring of subsurface environments have been going on.
- Assessments of natural and social data in each city, and the structure of project database based on GIS have been made.
- Land cover/use maps based on GIS with 0.5 km mesh have been made at three development stages of Tokyo and Osaka, and current stage of other five cities.
- 2nd International Symposium of this project was held at Bali on Dec. 2007 (which was authorized as side event of COP13), and the proceeding of the symposium was published.
- Results on the impacts of climate change and heat island was published as a special issue of International Journal (VZJ), and was cited by Open Science News "Scitizen".
- Cross cutting theme such as relationship between religion and groundwater has been started in Bangkok and Jakarta.
- Preliminary models such as GRACE, groundwater flow, and DPSIR+C have been established in each sub theme.
- In order to evaluate the origin and process of material loads to subsurface, isotopes and chemical analyses of water samples have been made, and new tracers (CFC, Kr etc.) techniques have been introduced.

(3) Future works and challenges

- In order to present the interim results of the project, special issue of STOTEN (Science of Total Environment, Elsevier) will be prepared.
- New approaches on the relationship between law/institution and groundwater (private water) /surface water (public water) will be launched.
- New working group will be launched to evaluate an integrated model and indicators.
- New observation system by uses of CFC, KR and absolute gravity measurement will be tested, and inter comparison with different observation methods will be operated.

Effects of environmental change on the interactions between pathogens and humans

The rapid spread of emerging infectious diseases is threatening human lives. Our project team aims to reveal the interactions between environmental alterations by human activities, outbreaks of infectious diseases, and changes in human lifestyle. We will suggest ways to prevent the outbreak and spread of infectious diseases and explain how to facilitate the safe coexistence of humans and pathogens.

Project Leader ■ **KAWABATA Zen'ichiro** RIHN

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WU, Deyi School of Environmental Science and Engineering, Shanghai Jiao Tong University, China

Research Aims

The spread of emerging infectious diseases is becoming a serious global environmental problem. To predict outbreaks of infectious diseases and to prevent epidemics, it is essential not only to conduct pathological studies but also to understand the interactions between humans and environments that cause and spread infectious diseases.

The objectives of this study are to clarify the anthropogenic environmental changes, pathogens, and human linkages to help deal with emerging infectious diseases proactively, before they become a major health threat, through an understanding of the nature of disease, and contribute to the safe coexistence of humans with pathogens to realize long-term societal security

Research Methods and Organization

Outbreaks of mass mortality in carp, which have long been part of human food resource and culture, caused by the koi herpesvirus (KHV) disease have occurred worldwide since 1998. Specifically, we will focus on the relationships between environmental changes in a freshwater ecosystem, KHV, common carp (*Cyprinus carpio carpio*), KHV disease and humans. We regard this system as a model of interactions between pathogens and humans (Fig. 1), because parameters common to other diseases are involved in the system and also this system allows us to conduct experiments to verify the interactions. We will then establish a general model for the emergence and spread of diseases (Fig. 2).

Fields surveys are mainly conducted at Lake Biwa, Japan, and Lake Erhai, China. Our project is organized into five research groups, an executive group, and an advisory group. The role of each group is as follows:

Environmental alteration by humans (Group 1): revealing the effects of anthropogenic environmental alteration on the emergence and spread of a pathogen (KHV) and on the behavior of its host common carp.

Ecology of pathogens and their hosts (Group 2): clarifying the dynamics of a pathogen (KHV) and its host (common carp) in relation to environmental factors, thereby defining the environmental factors involved in KHV infection.

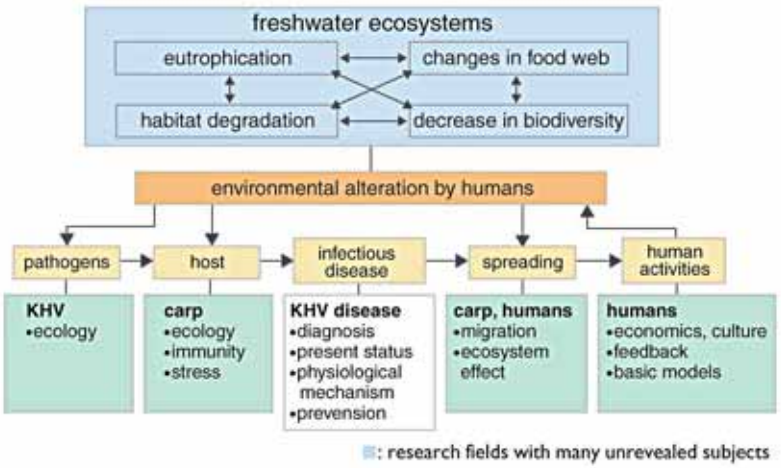
Infection and spread process and ecosystem effects (Group 3): revealing the infection and spread process and the effects of KHV disease on ecosystem functions such as material cycling.

Economics and culture (Group 4): clarifying losses in terms of ecosystem services, economics and culture as a result of KHV diseases, and the compensation process for those losses.

Feedback (Group 5): clarifying the effects of those losses on subsequent environmental alteration by humans.

Executive: coordinating the activities of each group to connect the research subjects to attain our objective. Applying our model to other infectious diseases.

Figure 1 Interactions between KHV disease and humans



■: research fields with many unrevealed subjects

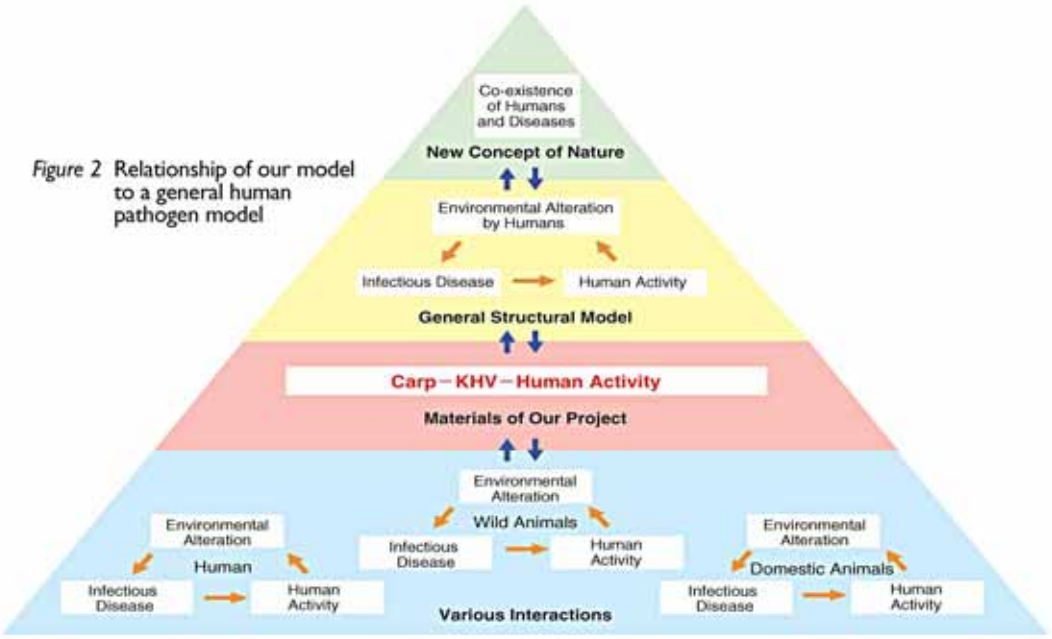
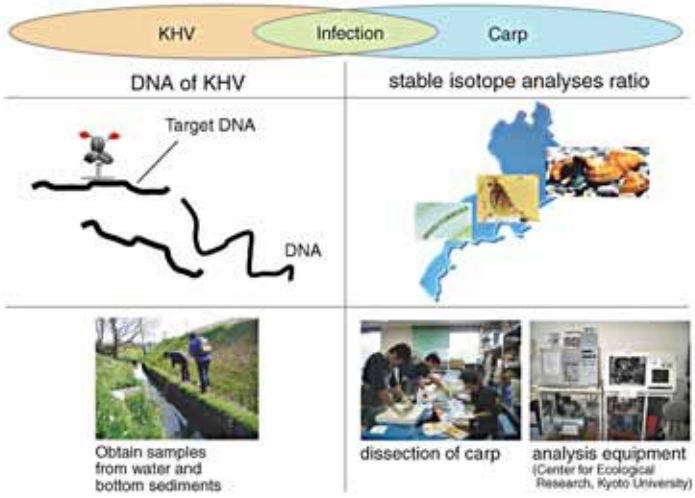


Figure 2 Relationship of our model to a general human pathogen model

Figure 3 Survey of distribution of KHV and behavioral range of carp to predict the outbreak of infectious diseases



Advisory: giving us suggestions to improve our project from the viewpoint of international experts.

Results in 2007

1) We surveyed the topology, bottom quality, and water quality of four satellite lakes of Lake Biwa that seemed to be important habitat for common carp. We found heterogeneous environments in these lakes. It was suggested that these environments may affect the behavior of common carp. A mathematical model, based on the hypothesis that common carp migrate between the satellite lakes seeking better habitats, predicted that lower connectivity among satellite lakes increases the stress carp experience and enhances the spread of KHV.
2) A pre-survey was conducted in Lake Erhai, China, with Chinese collaborators.
3) We established a method to detect KHV in lake water.
4) We collected carp from seven sites in Lake Biwa to obtain materials for stable isotope analyses and identified their behavioral range (**Fig.3**).
5) We developed a method to measure cortisol in water as a stress -induced hormone. We conducted a preliminary stress experiment using breeding tanks for common carp with a controlled water temperature.
6) We measured antibodies against KHV in blood and detected KHV in tissues of common carp.
7) We began our study of the effect of common carp extinction on humans.
8) We exchanged information about some infectious diseases with other research groups to find common parameters involved in infectious disease outbreaks.
9) We have integrated results from each group into the basic structure of the interactions between pathogens and humans.

Scheduled Research Activities in 2008

1) Clarify the behavior of the common carp in a lake using radio telemetory system.
2) Clarify the behavior of the common carp with a KHV antibody that reveals the history of KHV infection, and shows the places where the infection is likely to occur.
3) Reveal the distribution of KHV in Lake Biwa.
4) Clarify the environmental characteristics of the places where KHV and the carp are both present.
5) Reveal the relationship between environmental factors and stress through experiments.
6) Try to assess the economic impact of the disappearance of the carp.
7) Create a preliminary model of the effect of environmental change on the interactions between KHV and humans.
8) Analyze cases of other infectious diseases from the viewpoint of their interaction with humans.
9) Conduct a survey on spatial distribution in water temperature in Lake Erhai, China.
10) Provide multidimensional assessment of environmental change on the interactions between pathogens and humans from the perspective of the local residents.
11) Collaborate with an international program of biodiversity science (DIVERSITAS).
12) Hold an international symposium on Environmental Change, Pathogens and Human Linkages at RIHN, Kyoto.

Global Warming and the Human-Nature dimension in Siberia
——The social adaptation to the changes of the terrestrial ecosystem with an emphasis on the water environment

Siberia is one of the areas where global warming will be most evident, and perceivable changes in the climate, ecosystem and permafrost have already been reported in recent years. The change of natural processes, the capability of multi-ethnic population to adapt to the changes, and the interaction between the nature and the human activities are studied with the international flame work.

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Research purpose

The climate change accompanied by the enhanced variability of climate is expected to impact on the mechanism of social and cultural activities through the ecosystem and water environment change. The objectives of this project are (1) to understand the change of water and carbon cycle caused by the global warming and (2) to predict the impact on the socio-cultural aspects of the society.

Research method and area

The target research area is assigned to East Siberia, Lena River Basin. Field study results on the water and carbon cycles are scaled up by satellite data, and the validated model predicts their future change. In a similar manner, based on the field study of urban and rural inhabitant activities, we predict their future focusing on the indigenous-local environmental perception, the food production activities of indigenous hunters and pastoralists, and the social infrastructure constructed by Soviet style modernization.

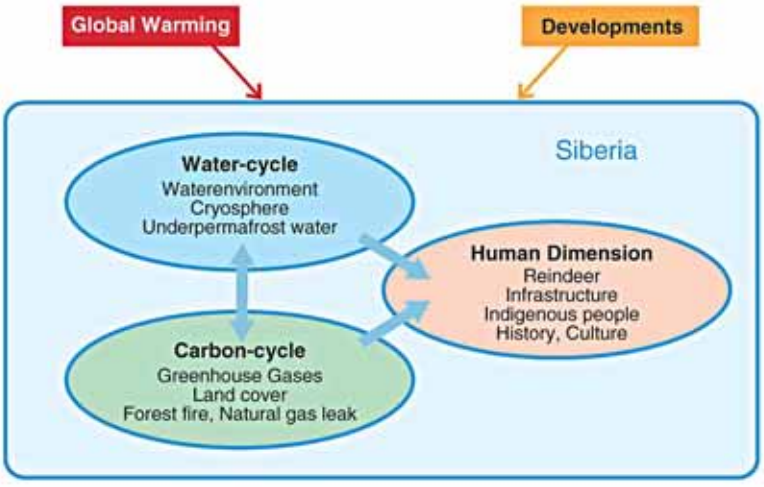
Expected result

The results of the research in Siberia have the social value in the form of Early Warning addressing the issue of global warming. The carbon budget over Siberia is comparable with that over the tropical forest, and the reduction of global warming feedback uncertainty of carbon cycle is important. The importance of social and cultural factors in the impact assessment will be indicated which have been ignored because they are difficult for the global climate impact prediction model to take into account.

Photo Melting permafrost in the area facing to Arctic Ocean

The global warming and rapid development will cause the drastic change of the water environment (including snow and permafrost) and ecosystem (including the greenhouse gas budget) in Siberia. Their impacts on the human society both in urban and rural area are assessed based on the field study and socio-cultural and historical points of view.

Figure Flow chart of the project



Urban Circularity and Diversity:
Future Possibilities for a Great Complex System to Bridge the Human Race and Global Environment

Cities are a result of highly dense human agglomeration, which has heavily burdened the global environment. On the other hand, cities are also an assemblage of human wisdom that allows us to coexist with our environment. In order to investigate this complex system, we will adopt "circularity" and "diversity" as our viewpoints from which we can observe human value system, institutions, population, urban environmental resources, and other factors vis-à-vis multidimensional time-space coordination. The purpose of this study is to comprehensively evaluate both positive and negative urban impact upon the global environment based on the result of our investigation, and make proposals regarding the future of our cities.

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Photo Urban landscape, Jakarta, 2006

Here, people, commodities, capital, and information flow in from all over the world and transform the city. We will conduct a historical investigation of these factors and consider future possibilities for our cities by focusing on their diversity.

The Background and the Purpose of the Research

Currently, more than half the human activities on earth occur in cities. The urban concentration of people, commodities, capital, and information has been accelerating. This phenomenon is not only a result of global-scale mobility but also of migration from rural and suburban areas to the urban centers. People, commodities, capital, and information, once concentrated in a city, are amplified, consuming and wasting global resources — water, wood, farmland, and air — and as a result, rubbish, discarded lumber, carbon dioxide, and waste water are discharged.

Many of our environmental problems on the earth are caused by such urban consumption and discharge, which in turn should adversely affect the environment of the city itself. However, urban activities consist of so many different elements, and these various phenomena, while being bound by historical and civilization related factors, travel across urban and national borders, making it difficult for us to grasp them, let alone control them. This study is an attempt to grasp and analyze such phenomena of urban migration and sojourn, namely phenomena of urban circulation, which have been too complicated for any investigation so far, by means of various academic approaches. Furthermore, it attempts to investigate future possibilities for our cities by focusing on their diversity as a barometer.

The Research Methods and the Expected Tasks

We have chosen Southeast Asia as the focus of our study — particularly Jakarta and its urban circulatory sphere — as this is the area where the struggling forces of globalization converge and whose urban environments are being heavily degraded. We are also going to study Scandinavia — particularly Copenhagen and its circulatory sphere — in order to make a comparison with Southeast Asia. We will deal with the urban circulatory mechanism vis-à-vis people, commodities, capital, and information during the period from the end of the eighteenth century, when a great change was caused by the British Empire's making inroads into the region, to the present. We will study our subjects over the long-term (across a span of about 100 years), mid-term (across a span of about 30 years), short-term (across a span of about 10 years), and very short-term (within a span of one year). Out studies will be conducted cross-disciplinarily, involving various academic fields such as economic history, urban history, transportation engineering, religious studies, and the history of ideas. Thus, we will observe and compare the two target cities and clarify their dynamic structures.

We will also examine which elements are responsible for the degradation of the earth's environment. Based on our results, and by introducing the concept of urban diversity, we would like to construct a model for sustainable urban regeneration that will improve urban as well as global environmental problems and lead to future-oriented and practical urban policies. Finally, we will choose approximately 150 cities that humankind created on the earth and study their histories of rise and fall. This investigation, together with the study of our two target urban circulatory spheres, will allow us to build an inventory of urban wisdom and failures, which in turn will nurture future possibilities for our cities.

Study of regional diversity of water quality: toward water management based on circulation

Global viewpoint becomes indispensable for the management of aquatic environment even in a local area because of the enlargement of human impacts on the atmosphere and the globalization in the society. This project aims to develop a method to diagnose the natural and artificial effects on the water quality, propose an environmental index to show the globalization signature in water, and arrange methods for the local water management which is adaptable for the global environmental change.

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Research purpose

The major subject of watershed management has been changed from the water mass problems to the water quality ones. As water contains materials derived from the watershed and foreign countries, elucidating the global circulation structure of materials in nature and society becomes indispensable for the better management of local water.

Research method and area

Utilizing the advanced traceability technique by integrating various geochemical and isotopic analysis methods, we will identify the source of components in water and classify them into a local source and a global one. Based on this traceability diagnosis, we will develop an effective monitoring method to sustain the water quality and support the water management by local governance dependent on its social and natural characteristics.

Expected result

The traceability diagnosis will increase in the analytical precision for the material flow in nature and human society, and can identify the source area and its size of materials in a local environment. It will lead to evaluating the water safety based on the precaution rule, establishing a new water index to evaluate the contribution of foreign materials, and improving the environmental consciousness of people, which is the basis of the water management based on circulation.

Photo Popular Koubou-water welling from the seafloor in the Saijo city of Ehime prefecture.

The photos in the lower right and left are the enlargement of the Koubou-water. Groundwater of good quality in Saijo is the basis of municipal lives. However, the mountainous area of recharging groundwater has been in a state of forest devastation and receiving atmospheric pollutants from the Asian continent, whereas the plain area is concerned with various human impacts and saltization due to the rise of sea-level. Thereby, the future management plan of the total watershed is prerequisite.

In the field we encounter people of different ethnic groups, with different languages, cultures, histories and customs. The environmental problems they face also vary from region to region, but all share one common planet Earth. Their problems are our problems, and together we must seek solutions.

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Photographers (locations)

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4 MOJI Kazuhiko (Laos)
5 ABE Tomoko (Vietnam)
6 UMETSU Chieko (Zambia)
7 OKUMIYA Kiyohito (Yunnan, China)
8 HIDAKA Toshitaka
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