Historical evolution of the adaptability in an oasis region to water resource changes — the scheme and the introduction of the project —

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Outline of the project:

(Objective)

The location of oases and people's lifestyles have been greatly changed historically in response to the water resource changes associated with global change in the arid and semi-arid regions of central Eurasia. The present project examines the historic interaction between humans and natural systems, by analyzing historical documents and a variety of proxies, in addition to analyses of the present adaptability of the region to water resource changes essential for people's life.

(Methodology)

Water resources in the region considered are mainly the precipitation in the mountains and the melt water of glaciers, which change in response to global climate change and possibly a change in lifestyle of the people in the region. People have used the limited amount of water resources and developed their own culture by adapting to the changes in water resources. In the present project the historical change of both water resources and water demand/utilization is investigated by analyzing historical documents as well as a variety of proxies such as ice cores, lake sediments, tree ring samples and wind brown deposits. For interpreting the information, current processes of water circulation systems including the social utilization of water, are investigated with field observations: precipitation process, accumulation and ablation process of glaciers, river and ground water discharge processes, irrigation and evaporation/transpiration (evapo-transpiration) process, *etc.* Through these investigations, the adaptability of water resource changes of the region is assessed historically, and a model for evaluating this adaptability is developed to examine the mode of living in the region for future generations. The study, hence, will elucidate the historical process of cultural development and the criteria that decide the lifestyle of the people in the region, which should contribute to finding a desirable mode of living for the future.

(1) A drainage basin is selected in the arid and semiarid regions in central Eurasia, and each process in the water circulation system, such as precipitation process, glacier melt process, discharge process of surface and ground water and evapo-transpiration process in the irrigation system *etc.*, are observed, and the causes for changes in the water circulation system are investigated.
(2) The water demand/utilization processes in the region is examined in such activities as irrigated agriculture, nomadic activities, forestry, industry and the other businesses. The conflict and/or the mutual cooperation between these water utilizations are investigated in relation to the social system, religion and cultural situation in the region through such studies as socioeconomic analysis.
(3) Historical documents and various proxies (ice core, tree ring, lake sediment and wind brown deposit *etc.*), obtained in and around the region, are analyzed to reconstruct the historical evolution of water resources and water demands in addition to archaeological investigations. For interpreting these sporadic data, the studies mentioned in (1) and (2) above are essential.
(4) Based on these results, a model is developed for analyzing the historical adaptability to water resource changes, and examine a suitable mode of living in the region for the future.

(Expected Results)

By examining the history of the interactions between humanity and nature in arid and semi-arid regions in

central Eurasia, where the social and natural systems are significantly vulnerable to water resources changes, it would be possible to model the interaction and the validation. To develop a historical perspective of this interaction would provide an important clue for human beings at present, who face serious global environment problems, how to live with their environment, and to potentially create a new concept of living for a well-adapted future capability.

(Why arid and semi-arid regions in central Eurasia)

Central Eurasia is a region where people have been most active historically, living mainly in either farming or nomadic activities. The mixture of the both cultures and the people have produced new types of human cultures by becoming acclimated to the nature of the region. Central Eurasia has been considered the region where information and a variety of goods representing the culture of the West and the East have passed through, having helped an exchange between the two. It has been pointed out recently, however, that it is not only a transit region, but the people in the region have assimilated the information successfully, and developed their own outstanding culture, having been the leading people in the human history of our planet. In addition, "advanced" industrial activities have intensified recently, which presumably have caused the "environmental problems" of the region. One of the advantages lies in that a number of documents written in Chinese, Persian, Turkish and other languages describe the history for about 2000 yeas of the region, which is essential for the present study.

Outcome of the feasibility study in 2001 fiscal year:

(Outline)

The research team has been organized and the implementation plan made. Namely, research institutions in China have been investigated to determine their level of cooperation, and a drainage basin was selected for the major field work. The availability of historical documents and various proxies were examined in and around the basin, and a preliminary field investigation was made. The results have been reviewed by the research team to create an implementation plan for the 5-year project.

1. Collaboration with Chinese institutions

The present project requires a very large study area spectrum covering natural sciences, social sciences and human sciences. It was considered difficult, therefore, to collaborate with a single institution in China on the project. The following institutions were hence visited to discuss the potential collaboration: Chinese Academy of Sciences (CAS), China Meteorological Administration (CMA), Institute of Geographical Sciences and Natural Resources Research (IGSNRR), Nanjing Institute of Geography and Limnology (NIGL), Nanjing Institute of Hydrology and Water Resources (NIHWR), Tsinghua University (TU), Institute of Modern History (IMH), Institute of Archaeology (IA), Institute of History (IH), First Historical Archives of China (FHAC), Institute of Nationality Studies (INS), Cold and Arid Regions Environment and Engineering Research Institute (CAREERI), Lanzhou University (LU), Northwest Normal University (NNU), Institute of Geochemistry (IG), China Institute of Water Resources and Hydropower Research (CIWRHR), and Inner Mongolia Autonomous Region Historical Relic Engage in Archaeological Studies Research Institute (IMARHREASRI). Also the potential for the collaboration was discussed with researchers from Hunan Normal University (HNU), Institute of Global Environment (IGE), Central University of Nationalities (CUN) and Nanjing University (NU). All the institutions were very responsive to the collaboration.

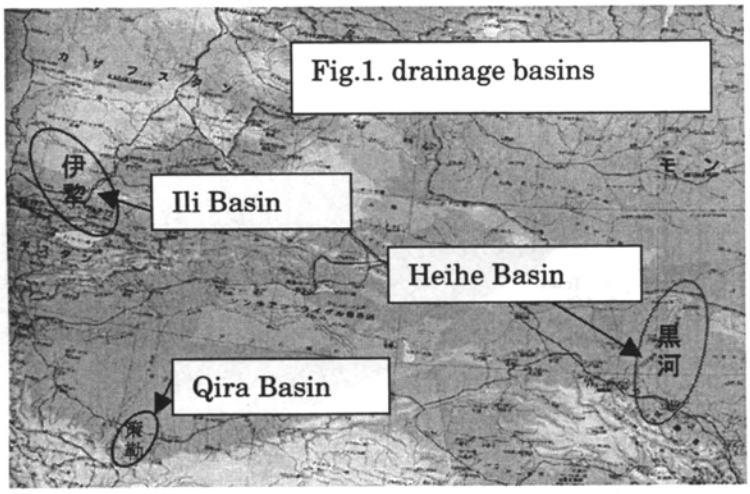
As will be described later, the Heihe River Basin was chosen for the main field, and CAREERI and INS were considered core institutions for the collaboration, because they had accumulated much research experiences, and are still active in field research in the basin. In addition, the following institutions were considered appropriate to initiate collaboration: IGSNRR, NIGL, IA, IH, NNU, NU, IG, HNU, CUN, LU, IMARHREASRI, FHAC and NU. Collaboration agreement has been already signed between the Research Institute for Humanity and Nature (RIHN), and CAREERI and INS. Implementation agreement was also signed with NU, NIGL. This type of agreement will also be singed with the other institutions as necessary. Additional institutions may be involved for collaboration as the project evolves. Table 1 shows a list of major researchers and their institutions.

Table 1 Major collaborating researchers in Chinese institutions

氏　名	FAMILY, Given name	Institution	Major research fields
程　国棟	CHENG, Guodong	CAS, Lanzhou	Analysis of water demand
姚　檀棟	YAO, Tandong	CAREERI	Ice core analysis
康　尔泗	KANG, Ersi	CAREERI	Water circulation analysis
丁　永建	DING, Yongjian	CAREERI	Water circulation analysis
張　斉兵	ZHANG, Qibing	CAREERI	Dendro-chronological analysis
夏　軍	XIA, Jun	IGSNRR	Water circulation model
李　世傑	LI, Shijie	NIGL	Lake sediment analysis
万　国江	WAN, Guojiang	IG	Isotope analysis
袁　　靖	YUAN, Jing	IA	Pollen analysis
張　万昌	ZHANG, Wanchang	NU	Remote sensing
時遠	HAO, Shiyuan	INS	Socioeconomic analysis
色　　音	SAIN	INS	Social anthropological analysis
鍾　進文	ZHONG, Jinwen	CUN	Nomad analysis
李　并成	LI, Bingcheng	NNU	Archaeological studies (Gansu)
謝　自楚	XIE, Zichu	HNU	Ground water analysis
魏　　堅	WEI, Jian	IMARHREASRI	Archaeological studies (Inner Mongolia)
呉　元豊	WU, Yuanfeng	FHAC	Document analysis (Qing Dynasty)
陳　高華	CHEN, Gaohua	IH	Historical documents analysis

2. Study basin

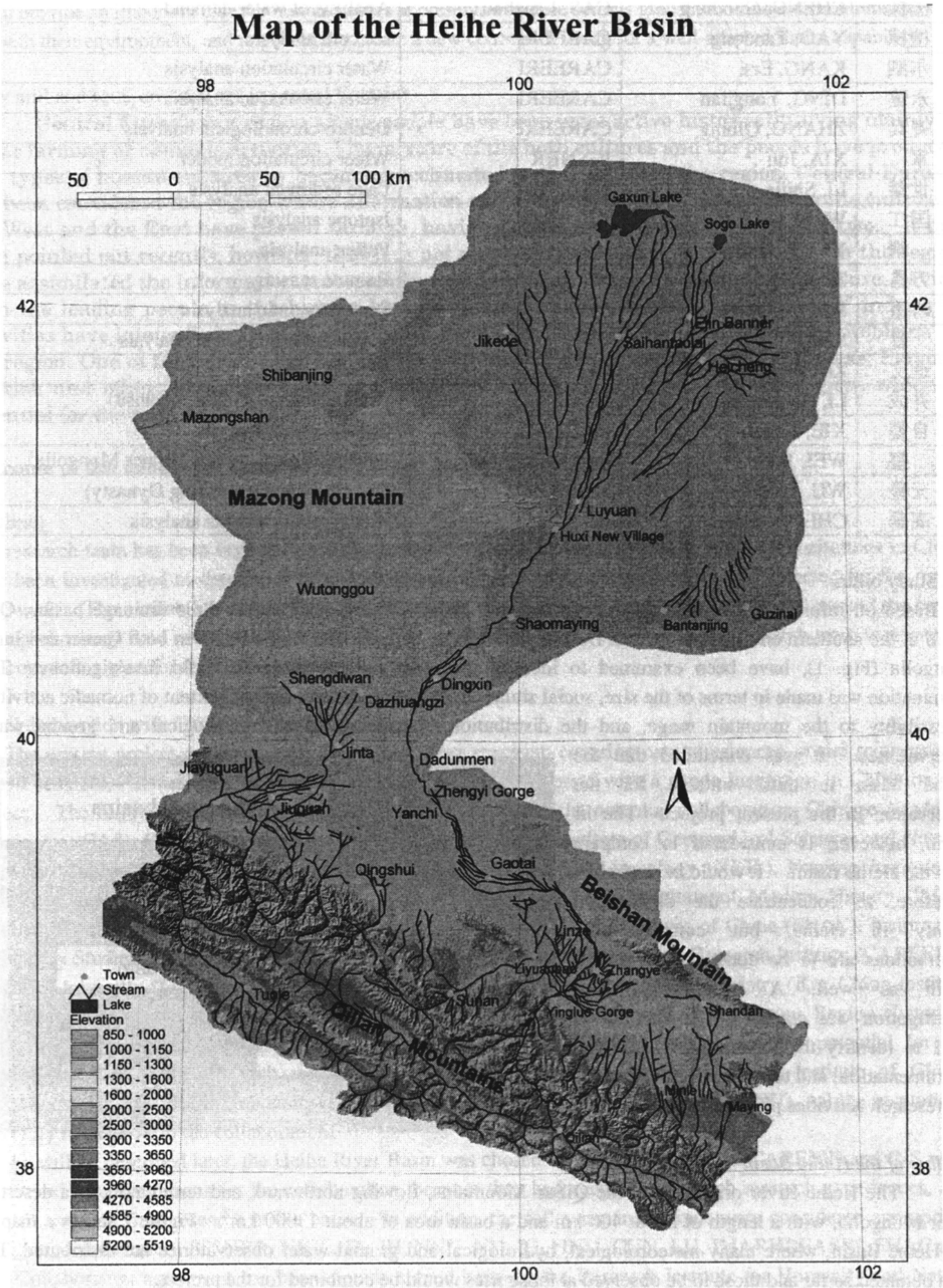
Based on information at hand and obtained at the above Chinese institutions, three drainage basins, Qira Basin at the southern end of Taklamakan Desert, Ili Basin in Junggar, and Heihe Basin in both Gansu and Inner Mongolia (Fig. 1), have been examined to identify the most suitable basin for field investigations. The examination was made in terms of the size, social situation, irrigation system, size and extent of nomadic activities, accessibility to the mountain range, and the distribution of meteorological, hydrological and ground water observatories. It was concluded that the Heihe basin is most suitable for the observation in the present project. The Ili Basin, however, is considered to compare with the Heihe Basin. It would be desirable, therefore, to concentrate the observation mainly in Heihe, but complimentary observations are to be conducted in the Ili Basin as well. A preliminary field investigation was carried out in the fall of 2001 to identify the locations of additional instrumentation, and to have an initial draft of the research activities planned for 2002.



Outline of the Heihe Basin

The Heihe River originates in the Qilian Mountains, flowing northward, and terminating in a desert in Inner Mongolia, with a length of about 400 km and a basin area of about 13000 km^2. Figure 2 shows a map of the Heihe Basin, where many meteorological, hydrological and ground water observatories are distributed. The data obtained so far and those to be observed at those sites would be combined for the project.

Fig. 2


Map of the Heihe River Basin
98
100
102
42
40
38
50 0 50 100 km
Gaxun Lake
Sogo Lake
Ejin Banner
Jikede
Saihantaolai
Haicheng
Shibanjing
Mazongshan
Mazong Mountain
Luyuan
Huxi New Village
Wutonggou
Shaomaying
Bantanjing
Guzinai
Shengdiwan
Dingxin
Dazhuangzi
Jinta
Dadunmen
Jiayuguan
Zhengyi Gorge
Jiuquan
Yanchi
Qingshui
Gaotai
Beishan Mountain
Linze
Liyuanhe
Zhangye
Tuole
Sunan
Yinglue Gorge
Shandan
Qilian Mountains
Minle
Maying
Qilian
N
Town
Stream
Lake
Elevation
850 - 1000
1000 - 1150
1150 - 1300
1300 - 1600
1600 - 2000
2000 - 2500
2500 - 3000
3000 - 3350
3350 - 3650
3650 - 3960
3960 - 4270
4270 - 4585
4585 - 4900
4900 - 5200
5200 - 5519

The Research Prevention Research Institute, Kyoto University, in the early 1990s conducted observations on water circulation near Zhangye, one of the largest oases in the basin. This was collaboration with one of the institutes now forming the Cold and Arid Regions Environment and Engineering Research Institute. Their data covers only a couple of years, but their on-aging data are open for public. One example of these data is shown in Fig. 3, where air temperature and precipitation are plotted with solid line and bar, respectively, with gray color for a site in a desert 50 km north of Zhangye and darker color for Zhangye. It is noted that air temperature is 20 to 25 ℃ in summer, and −5 to −10 ℃ in winter. Annual precipitation is about 140 mm in Zhangye, and about 90 mm at the desert station. Precipitation takes place mainly in summer season at both stations.

River discharge is shown in Fig. 4 for both upstream (Yingluo Xia) and downstream of Zhangye (Zhengyi Xia). At the former site, the discharge is about 60 m^3s^{-1}, and the division of the figure by the area of the basin upstream of the observation site resulted in the annual precipitation of about 600 mm. This indicates that the precipitation at high elevations is very significant, since it is only about 100 mm/year near and downstream of Zhangye. This is demonstrated in Fig. 5, where altitudinal distribution of precipitation is shown. As mentioned above, annual precipitation at elevations of about 1500 m, where Zhangye is located, is about 100 mm, while it increases almost linearly as the elevation increases. An extrapolation of the linear trend gives the annual precipitation of about 1000 mm at the elevation of 4000 m, which is roughly the height of the peaks of the Qilian Mountains. It is considered, therefore, that the water available for people comes mainly from the mountains.

Discharge becomes higher in summer at a site upstream of the oasis, and also in winter at a site downstream, as shown in Fig. 4, indicating that significant amount of water is taken out of the river by the people in the oasis in summer. One of the results uncovered by Kyoto University and the

Fig. 3. air temperature and precipitation

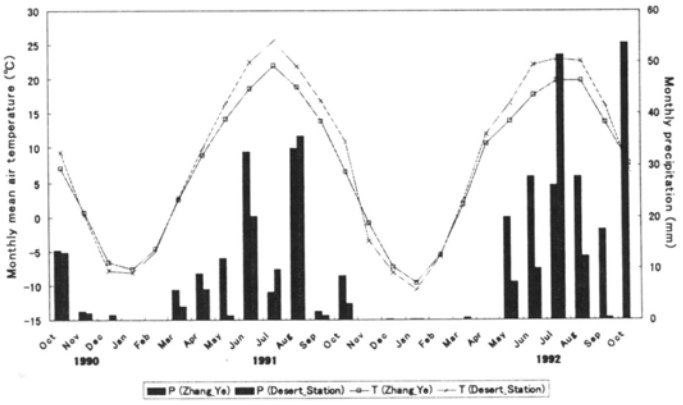


Fig. 4. Discharge of the Heihe River

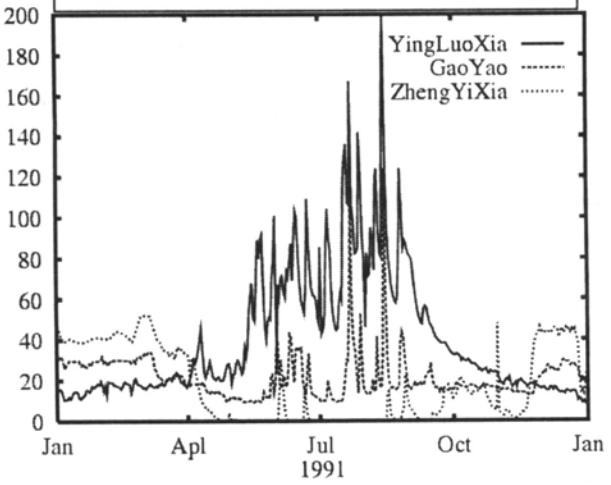
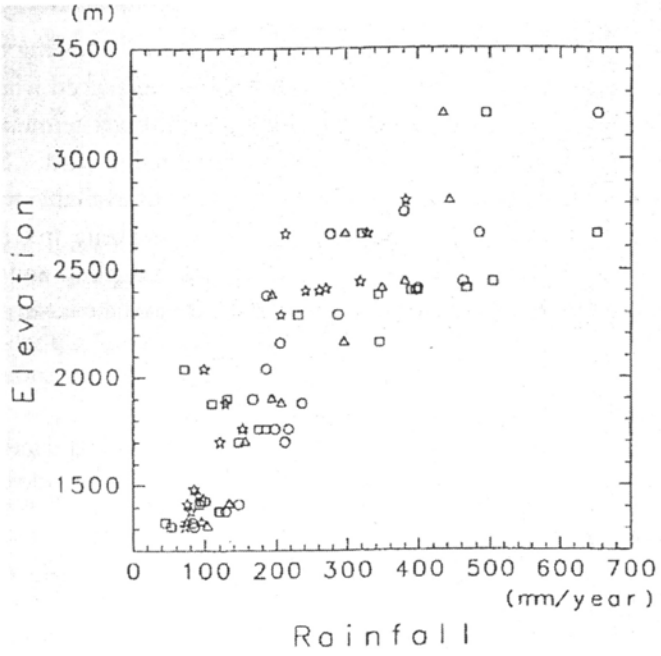


Fig. 5. Precipitation

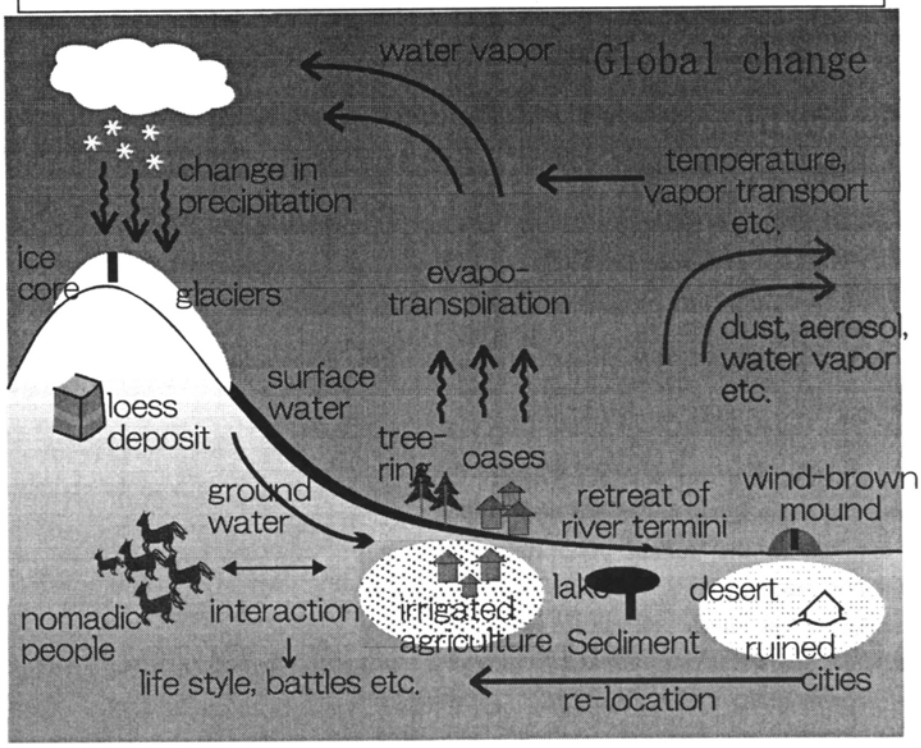


present CAREERI indicates that annual evapo-transpiration is roughly 500 mm over farmland in the oasis, and about 100 mm even in the desert. Since annual precipitation is about 100 mm near and downstream of Zhangye, the precipitated water is just evaporated toward the atmosphere. The water used for additional evapo-transpiration of about 400 mm in farm land, which is the water used for farming, is compensated by the river flow from the mountains originating in precipitation in the mountains and the melt water of glaciers. The discharge at a site downstream of the oasis increasing in winter seems to indicate that the water stored in soil in summer comes back to the river downstream.

Preliminary investigation of the region, made in the fall of 2001, indicated that the drainage basin can be divided into 5 different zones depending upon altitude. ①mountain zone where glaciers are located and almost no people stay; ② piedmont zone where nomadic activities are intense; ③ oases zone where irrigated farming is predominant with only recent industrial activity; ④desert zone, but where irrigated farming has increased rapidly; and ⑤ terminal zone where both farming and nomadic activities were predominant, but shortage of water became significant recently.

A schematic representation of the basin is shown in Fig. 6. Appreciable precipitation takes place in the mountains mostly in the form of snow, part of which is trapped in glaciers. They are the major water resources of the discharge through rivers and ground water flow. Flowing downward, the water is lost through evaporation and transpiration toward the atmosphere, which is enhanced when an irrigation system is developed. As the result, discharge water decreases downstream, and the river terminates inland where lakes are sometimes formed. There are many ruined cities, some of which are buried in sand. Some of the cities appear to have relocated upstream, probably because of the change in the amount of available water. In the basin, there are many sites where many proxies such as ice core samples, wind brown deposits, tree ring samples, lake sediments are available. These will be described in the following section. The sampling and analyses of the proxies will provide useful data to compare with document records left in and around the basin.

Fig. 6. Schematic representation of the basin



3. Availability of hisorical materials

With data at hand, the availability of historical documents has been examined. The results are shown in Table 2, where the amount of data available is given for various languages and time span.

Archaeological materials:

Found mostly in ruined cities and tombs. In the early stage, bronze works and letters carved on bones and tortoise carapaces are typical. Since AD, varieties of daily tools and equipment have become available. Relic houses are found during any era. After the 16th century, archaeological materials are rarely available partly because of the personal rights of the descendants.

Table 2. Availability of historical materials

	Archaeological materials	Chinese sources	Mongolian sources	Uighur sources	Turkish sources	Tangut sources	Tibetan sources	Manchurian (Jurchen) sources	Persian sources	Arabic sources	Visual materials
Prehistorical age	○										△
B.C.8c-3c	○	△									△
B.C2c-1c	○	○									○
A.D.1c-2c	○	○									○
2c-5c	△	△							:		△
6c-750	○	○			△		△		:		○
750-900	○	◎			△		△		:	△	○
900-1100	○	◎		△		△	:		△	△	◎
1100-1200	○	◎		△		○	:	△	△	:	◎
1200-1400	○	◎	△	△		○	△	△	△	:	◎
1400-1600	○	◎	△				△	△	:	:	◎
1600-1750		∞	△				△	○	:	:	◎
1750-1900		∞	○		△		△	◎	△	:	◎
1900-		∞	○		○		○	◎	△	:	∞

Availability: ∞enormous ◎enough ○significant △some :little

Chinese sources:

Historical documents written with Chinese Characters, including authentic records, which is the history from the viewpoint of Chinese Dynasties. The history of the arid and semiarid regions in central Eurasia is described as well. Since systematic descriptions about the region have not been found, it is essential to examine authentic Chinese history. The other types of edited history become richer as time passes. For certain eras, original documents are available. Inscriptions on pieces of wood and bamboo in the era of Qin to Wei Dynasties, Heicheng Documents in the era of Xixia and Mongol, archives of the Qing Dynasty, and carved documents on stone monuments after the Tang Dynasty are examples. These original documents are crucial for reconstructing the social situation in the respective time periods.

Fig. 7. Cover page of published documents found at Heicheng City

Mongolian to Arabic sources:

Major documents are edited historical texts, which, however, include original data sometimes and reliable hearsay information. Carved documents on stone monuments are also very informative. Languages used in the area under the Qing Dynasty are available in archives of the dynasty after the 18th century.

Visual articles

Portraits and other illustrations carved on brick surfaces are often found for the Han Dynasty. Those found in Gansu and Shanxi Provinces are famous, with which detailed information about food; and clothing and even houses can be obtained for the era. Wall paintings r drawings found in tombs corresponding with various times and places are also very informative. It should be noted that pictures in general are of value not only from the viewpoint of art but also as a historical information source, which show life at the time in question. In the 20th century, the amount of visual articles increases rapidly because of innovation in photograph and film. In the

early stage, westerners and Japanese left those pictures to record their exploration in China or to satisfy their curiosity, but in the later stages, local people take pictures for their own records.

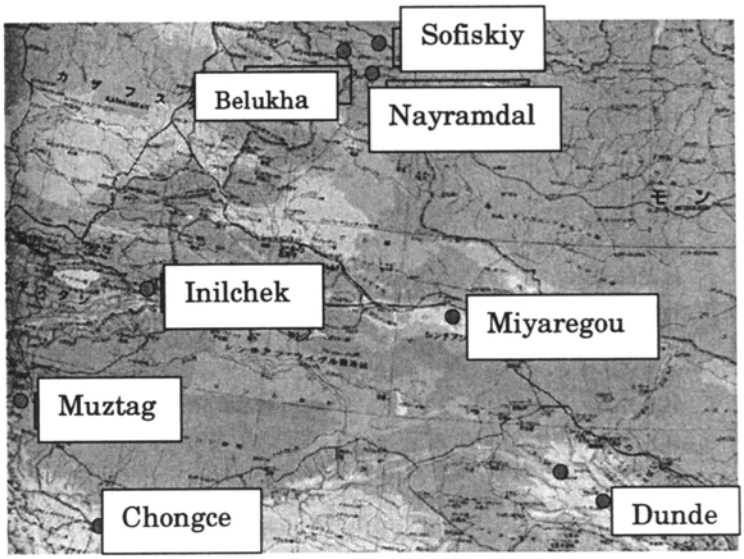
The availability of those documents and articles has been investigated, particularly in China, when the institutions given above were visited. Original documents were found at Juyancheng and Heicheng cities from the Heihe Basin, corresponding with the Han Dynasty and the Xixia-Mongol era, respectively. They have already been compiled in particular those written in Chinese characters, and published. Figure 7 shows a cover picture of the published documents obtained at Heicheng City. Official documents in the Qing Dynasty are kept in the First Historical Archives of China in Beijing, and most of them are found available for looking through, copying or photographing. They include meteorological and glaciological data in and around the Heihe Basin for the period from 1765 (Qianlong 30) to 1908 (Guangxu 34).

4. Availability of proxies

The availability of various proxies such as ice cores, lake sediment cores, wind brown deposits, and tree ring samples, has been examined in and around the Heihe Basin as described in the previous report. It was found that ice cores can be obtained at the Qilian Mountains, and lake sediment cores at Juyanze Lakes. It is considered desirable, however, to take multiple samples in order to get rid of the local effect for any proxy. The other potential sites for ice core retrieval are located in the Altai Mountains and the East Tianshan Mountains, and for lake sediment cores, at Jilantai Lake. The preliminary field investigations revealed that tree ring samples can be obtained from the Qilian Mountains as well as Ejina, near the Juyanze Lakes. This would allow us to carry out the inter-comparison between the records from different proxies.

The potential sites for ice core sampling are shown in Fig. 8. There are two sites in the Qilian Mountains: one at Dunde Ice Cap and the other glacier about 100 km northwest from Dunde. A China-US joint party has taken ice cores at Dunde Ice Cap in 1985. Detailed information is hence available for additional retrieval of ice samples for the present project. The latter site in the mountains, whose name is unknown, was suggested by CAREERI, but preliminary investigation would be required before the actual coring.

Fig. 8 potential sites for ice core retrieval

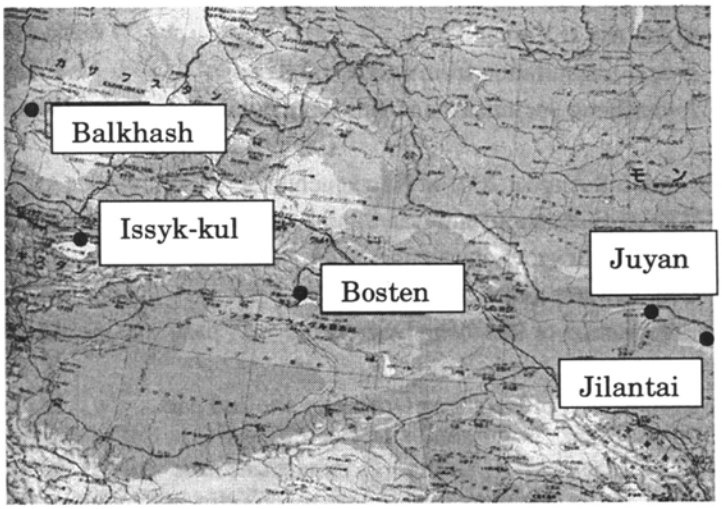


A joint team of Japan, US and Russia was organized and sent to Belukha in the Altai Mountains in the summer of 2001 for preliminary investigations of the site, such as installation of automatic snow depth gauge, ground survey and radio-echo sounding of the glacier. A 18-m long ice core has been retrieved and brought back to Japan. The sample was subjected to an analysis jointly with a team from the National Institute of Polar Research who obtained a 12.3-m long ice core from Sofiyskiy Glacier also in Altai. Glaciers in the Nayramdal Mountains have been investigated from a helicopter for identifying potential glaciers for future ice coring in July, 2001. The helicopter landed at two sites in the Russian Altai, and snow pit observations were made including the measurement of temperature distribution in the surface snow layers. The results, however, indicated no suitable coring site on the Russian side. From a view from the flight observation, there could be an attractive site for coring on a Potanina Glacier, which, however, is located in Mongol. Further examination would be required for an ice sampling in Mongol. Miyaregou Ice Cap in the East Tianshan Mountains is considered a promising site, but a preliminary study is necessary for this site as well. Previous reconnaissance indicated that the support of a helicopter was necessary for coring at the ice cap, and the feasibility of hiring a helicopter from the Chinese Army was investigated. The army's reply was favorable for the use of a helicopter for the transportation of equipments or ice samples, but the feasibility has to be checked prior to the actual operation, which is to be done later.

In the southwestern region, a US party succeeded, in 1998, in obtaining core samples from the Inilchek Glacier in the West Tianshan, and the data would be available shortly. From the Muztag Mountain, a China-French party plans to retrieve samples in a few years. Chongce is an ice cap where Japan has experience in obtaining cores, and the information for retrieval of another core is sufficient.

Possible sites for lake sediment sampling are shown in Fig. 9. A sampling from the Jilantai Lake was suggested by NIGL. A reconnaissance party, therefore, was sent in 2001. Preliminary analysis of the sediment core samples taken in 2001, however, showed that the laminar structure was disturbed, presumably because the core site was far from the center of the lake.

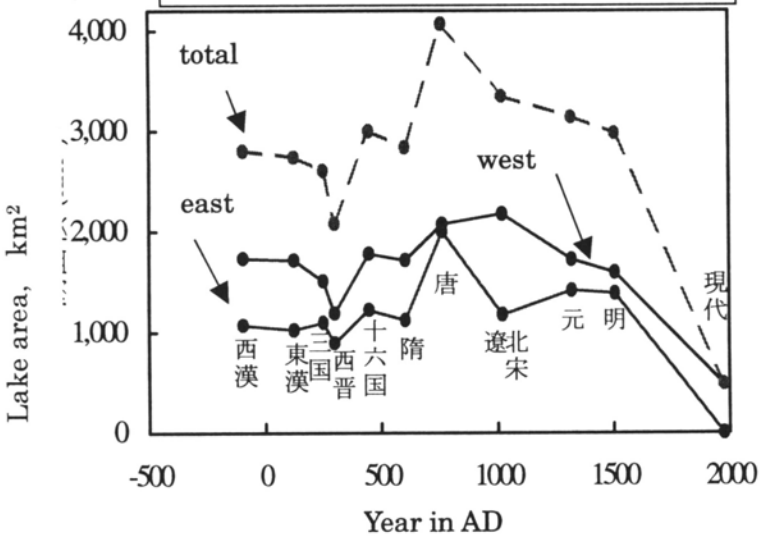
Fig. 9 potential sites for lake sediment samples



The Juyanze Lake, located at the terminus of the Heihe River, is considered an excellent site for the sampling for the present project. It used to be a one large lake, but was divided into two lakes, one to the east and one to the west. Referring to the Historical Atlas of China edited in the 1970s to 1980s and published in 1996, the temporal change of the lake area was investigated. The results are shown in Fig. 10. Because two lakes are plotted in the series of maps, the area of respective lakes are shown in Fig. 10 together with the total area. It is difficult to evaluate the reliability of the maps at present, but the lake area seems to have increased toward the 10th century, and become smaller afterwards. The disappearance of the eastern lake was reported to have occurred in 1998. Sampling from the already dried-up lake bottom is very easy. The site has been visited by a reconnaissance party, and it is feasible to obtain samples in 2002.

Looking at the west, a sampling was carried out in early 1990s at the Bosten Lake, and it can be a potential site. For information about Ili Basin, Balkhash Lake in Kazakhstan and Issyk-Kul Lake in Kirgiziya could be the potential sites.

Fig. 10. evolution of lake area



5. Planning for 2002 activities

The specialties of the researchers, listed in the Annex, who are going to promote the present project, are quite different each other. The objectives and mission of the project, however, should be commonly realized and understood by every participant. So far, three meetings by all members were held, and research tools and expertise for individual discipline were discussed, to assist common understanding. In addition to several intra-discipline meetings, the steering committee including members who represent each discipline, has been held six times, and implemented a feasibility study in 2001. Also, a study meeting was initiated where various documents written with various ancient languages are translated into modern Japanese by members able to read them, and the content is discussed by all members including natural scientists who have no other way to receive this information. A study meeting was held three times in 2001, and for the forth, an international workshop was held in January 2002, inviting 6 researchers from China. In the workshop, the knowledge about the project was updated, and further planning for the 2002 activities was discussed. The fifth meeting was held in March 2002. Followings are the list of presentations made in the study meetings so far. The Project Report on Oases-region (PRO) was published for mutual understanding between the participants, as a periodical, which contains mainly the presentations at the study meetings.

List of Study meetings during 2001 fiscal year

First, 13 July 2001 at Nagoya University

- Water use at Yarkand — S. Hori
- Evapo-transpiration from desert and oasis — I. Tamagawa
- Juyancheng documents and Heicheng documents — M. Sugiyama and T. Furumatsu

Second, 6-8 August 2001 at Kawaguchiko

- Glacier fluctuation, and water and heat budget — A. Sakai
- Behavior of groundwater — T. Akiyama
- Groundwater analysis — M. Tsujimura
- Introduction of Heicheng Documents 1st part — M. Sugiyama, T. Kinoshita, T. Furumatsu, and Y. Kato, S. Arakawa
- Introduction of Heicheng Documents 2nd part — M. Sugiyama, T. Kinoshita, T. Furumatsu, and Y. Kato, S. Arakawa
- The life and culture of nomads — Y. Konagaya
- Environment change in the last 2000 years revealed by ice core analysis — Y. Fujii

Third, 27 December 2001 at Kyodai Kaikan

- Preservation of farmland at Niger, western Africa — T. Nagano
- Reconstruction of past environment by sediment core analysis — K. Endo
- Water circulation in arid and semi arid region — Y. Ujihashi

Forth (International Workshop on Heihe) 7-9 January 2002 at Kyodai Kaikan

- Historical aspects of arid land in western China (E) — S. Hori (Konan U.)
- A preliminary study on the history of desert regions in Heihe Basin (C) — Li, Bingcheng (Northwestern Normal U.)
- Hydrological studies in the Heihe basin, western China (E) — Kang Ersi (CAREERI)
- Social and human caring for optimizing ecology along Heihe Basin (C) — Zhong, Jinwen (Central U. Nationalities)
- Agricultural development and the desertification in Inner Mongolia (J) — Sain (I. Nationality Studies)
- Ancient fauna of China's Northwest (J) — Yuan, Jing (I. Archeology)
- Reconstruction of climate and environment in western China by sediment core analysis (E) — Li, Shijie (NIGL)
- The ecohydrological variation and the relocation of ancient oases along the southern edge of Taklimakan Desert (J) — G. Omar and H. Takamura (Rissho U.)
- Water qualities and stable isotope compositions of river water and groundwater in the Keriya River Basin, Xinjiannng, China (E) — H. Takamura (Rissho U.) and, T. OHTA (U. Tokyo)

Group Discussion for making the implementation plan of 2002 field activities

- Sediment Core Group (Chair: K. Endo)
- Hydrology & History Group (Chair: J. Kubota)
- Ethnology Group (Chair: T. Ozaki)

General Discussion

Fifth, 12 March 2002 at Kyodai Kaikan

- Documents of Qing Dynasty kept in First Historical Archives of China
  Wu, Yuanfeng (FHAC)
- Mongolian nomadism - ethnological survey of Mongols
  -B.-O. Bold (NRC, Iceland)
- Remote sensing data analysis for water circulation in Heihe
  Zhang, Wanchang (NU)

The meetings with all members, and the steering committee also are going to take place to have a final plan for the implementation of the project.

The status of the present project:

Within the program of historical time research axis

The present project is placed within the framework of the program "Historical validation of 'sustainability' and 'development' through the interactions of human activity and changes in the global environment." The program plans to elucidate the evolution of the culture and the criteria for deciding people's lifestyle, which should contribute to examining a desirable mode of living for the future. The program plans to cover a time period of about 2000 years in the past, because written documents are available in that time period in general, without which detailed study is considered difficult. It is planed also to concentrate the study on the arid and semi-arid regions in central Eurasia, because Central Eurasia is the region where people have been most active historically and our present culture is considered to have descended from those developed in the region.

The present project is the first project being implemented within the framework of the program, and hence the project tries to cover the full period, *i.e. ca.* 2000 years. This is because that the first effort should cover the total period, and following projects should concentrate on a certain time periods of importance when so identified as a result of the first project. The main field of the present project is the area where a distinguished culture has been developed from the overlapping two different western and eastern cultures. At the same time, this area is a place where northern and southern cultures have crossed over as well. In other words, the Heihe region was the intersection of different cultures and played an invaluable role for cultures of any region of the world except the New World. It is crucial to start with the most important region first, and then to extend the study area to another region for comparison after appreciable results are obtained.

Relation with other projects underway

For forming an academic foundation to develop measures for solving global environmental problems fundamentally, the Research Institute for Humanity and Nature focuses on research to elucidate the "circle of interactions between humans and natural systems." Five programs have been put in place corresponding with the following five research axes: 1. Environmental change impact assessment axis, 2. Human activity assessment axis, 3. Spatial scale axis, 4. Historical time axis, and 5. Integration axis. The first two are kinds of process studies, missing ring for understanding the interaction. The third examines the relation of global phenomena to those taking place on a local scale, and regarded rather important by local people. The forth looks at, in particular, the time evolution of the interaction, and the fifth tries to integrate the results of the programs placed in earlier four axes. Taking into consideration the research plan of the institute, where different programs complement each other to realize the mission of the institute, the relation of the present project placed in the fourth program with the other projects placed in other programs implemented in 2001 is mentioned below.

Research elements are schematically shown in Fig. 11, where two major components of the project are presented: reconstructing the past history of the interaction, and examination of the process of interaction at present. The latter studies are crucial for the earlier reconstruction because past data obtained by documents and proxies are rather sparse in time and space.

The process studies include an investigation of how water is utilized in irrigated farming in the oasis region in the Heihe Basin and its relation with the recent climate change. This is very similar to the project "Impacts of climate change on agro-ecosystem in arid areas." The present project would hence contribute to this project because it would provide similar data at a different region in culture from the main fields of the agro-ecosystem project, which are Israel, Egypt, Turkey and nearby these countries.

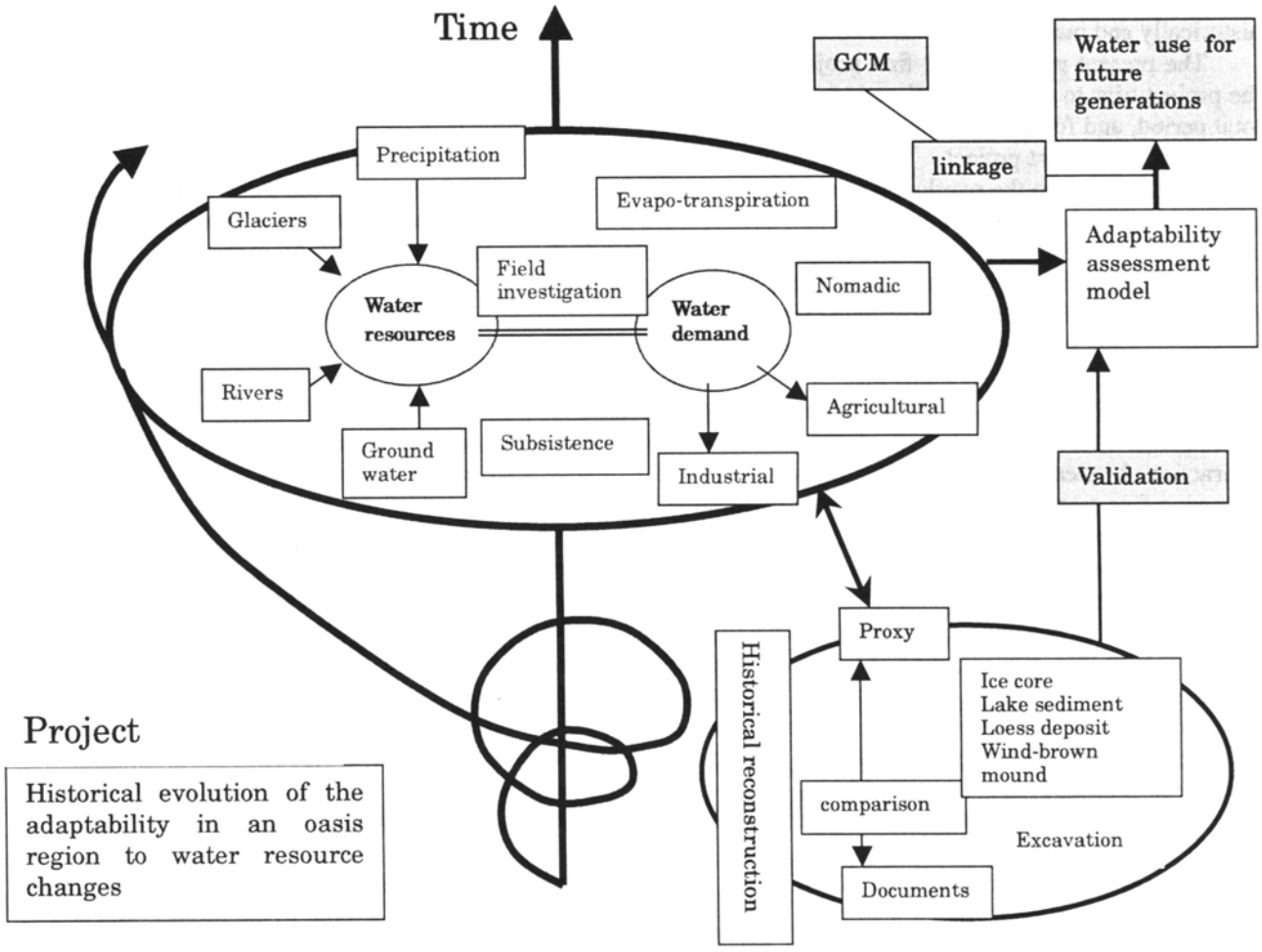
The Heihe Basin is one of the active areas where a significant amount of aerosols and particles are emitted.

The temporal change of the land-use or the desert area, to be examined by the present project, would, therefore, provide a historical point of view to the project "Research on the relationship between human activities and minor constituents in the atmosphere."

The third project, "Multi-disciplinary modeling for understanding interactions between humans and nature in the Lake Biwa-Yodo River watershed" tries to presents possible scenario for the watershed where human impacts are extremely large. This watershed could be the distant future of the Heihe Basin where human impact is not as intense. For examining the future of the basin, the situation in the Lake Biwa-Yodo River watershed is of a good reference, and *vice versa*.

The data to be obtained by the present project should be examined by researchers with many backgrounds. Document data, for example, are to be utilized by say natural scientists, and ice core data, which have been traditionally used by glaciologists only, are to be examined by say historians who have never had access. One of the outcomes of the present project, therefore, is a historical time database with a perspective on water, which is to be used by researchers of any background. The present project would hence contribute to the project, "Integrated water resources management system based on global environmental information library coupled with a world water model."

Fig. 11. Research elements of the project



Annex: List of participants (* steering members)

NAME	Affiliation	Contribution
NARITA, Hideki	Hokkaido University	Ice core analysis
SHIRAIWA, Takayuki	Hokkaido University	Ice core analysis
ENDO, Kunihiko*	Nihon University	Lake sediment analysis
MURATA, Taisuke	Nihon University	Lake sediment analysis
HORI, Kazuaki	National Institute of Advanced Industrial Science and Technology (AIST)	Lake sediment analysis
KOHSHIMA, Shiro	Tokyo Institute of Technology	Biological analysis
NARAMA, Chiyuki	Tokyo Metropolitan University	Geographical analysis
TSUJIMURA, Maki	Tsukuba University	Soil water
FUJII, Yoshiyuki*	National Institute of Polar Research	Ice core analysis
AZUMA, Kumiko	National Institute of Polar Research	Chemistry of ice cores
KOHNO, Mika	National Institute of Polar Research	Particles in ice cores
Huhbator	Showa Women's University	Social system analysis
YANG, Haiying	Shizuoka University	Social system
NAKAMURA, Kenji	Nagoya University	Precipitation
UYEDA, Hiroshi	Nagoya University	Precipitation
OHTA, Keiichi*	Nagoya University	Organic chemistry
FUJITA, Koji*	Nagoya University	Glacier change and ice core
SAKAI, Akiko	Nagoya University	Glacier fluctuation
MIYAKE, Takayuki	Nagoya University	Organic chemistry
NAKAZAWA, Fumio	Nagoya University	Organic ion analysis
AKIYAMA, Tomohiro	Nagoya University	Ground water
TAMAGAWA, Ichiro	Gifu University	Evapo-transpiration
SOHMA, Hidehiro*	Nara Women's University	Historical geography
UJIHASHI, Yasuyuki	Fukui University of Technology	Hydrological model
NAKAWO, Masayoshi*	Research Institute for Humanity and Nature	Data integration
WATANABE, Tsugihiro*	Research Institute for Humanity and Nature	Agro-economic analysis
KUBOTA, Jumpei*	Research Institute for Humanity and Nature	River discharge
YATAGAI, Akiyo	Research Institute for Humanity and Nature	Meteorological Analysis
NAGANO, Takahiro	Research Institute for Humanity and Nature	Irrigation system
KATO, Yuzo*	Research Institute for Humanity and Nature	Chinese documents
TAKEUCHI, Nozomu*	Research Institute for Humanity and Nature	Biological analysis
Mailisha	Research Institute for Humanity and Nature	Nomadic culture
SUGIYAMA, Masaaki*	Kyoto University	Persian documents
YAMAMURO, Shin'ichi	Kyoto University	Politics
YAMANAKA, Ichiro	Kyoto University	Archaeology
FURUMATSU, Takashi	Kyoto University	Chinese documents
ARAKAWA, Shintaro	Kyoto University	Tan gut documents
Kicengge	Kyoto University	Manchurian documents
KONAGAYA, Yuki*	National Museum of Ethnology	Nomadic system
HAMADA, Masami	Kobe University	Uighur documents
HORI, Sunao	Kohnan University	Oasis system
KINOSHITA, Tetsuya	Okayama University	Human philosophy
YOSHIDA, Setsuko	Shikoku-gakuin University	Ecology
KOBAYASHI, Osamu	Ehime University	Dendro-chronology
OZAKI, Takahiro	Kagoshima University	Nomadic system