Final Proceedings of International Workshop on The Yellow River Studies

-Kick off meeting-

January 27-29,2003

Kyodai-Kaikan(Kyoto-University)
Kyoto,Japan

Research Institute for Humanity and Nature

International Workshop on The Yellow River Studies

Organized by
Research Institute for Humanity and Nature (RIHN)
Inter-University Research Institute, Ministry of Education,
Culture, Sports, Science, and Technology, Japan

Preface

International Workshop on the Yellow River Studies was planned as a kick-off meeting for expanding and deepening not only scientific understanding of water circulation being occurred in the Yellow River domain, but also multi-disciplinary understanding of fact being occurred between natural phenomena and human activities under the severe climate condition. Thus consideration is basic and common comprehension which Research Institute for Humanity and Nature(RIHN) has been established in 2001. It is not so easy, but is challengeable and significant for us.

River water flows down to sea as open water or ground water with dissolved mineral component and precipitation which source is mainly evaporated water from sea surface and partially vapor water evaporated from land surface itself returns on land again. It is very simple but very difficult to estimate quantitatively still now. Moreover, we have little knowledge on effects of land use like irrigation to climatic change except of emission of carbon dioxide. Thus reason is background for planning of the Yellow River studies.

Fortunately, Professor Changming Liu, Chinese Academy of Science, has already been executing Chinese National Key Project relevant to Yellow River. And we have known Ocean university of China continues to pay attention to marine biological study in of Bohai Sea. Japanese and international scientists wish to collaborate with those studies and to get more integrated knowledge through our activities.

This meeting is expected to exchange information each other and discuss both implementation study plans. I would like to say heart full thanks for all of participants.

January 28, 2003

Yoshihiro FUKUSHIMA
Chairperson of the Workshop
Research Institute for Humanity
and Nature
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Scope

The Yellow River does not reach often to the Bo-Hai Bay since 1970's because of huge amount of water uses for irrigation at midstream. Water shortage for industrial and drinking water and irrigation occurred, and shortage of river water induces water pollution, drastic decrease in groundwater level and decrease of nutrient transports to the Bo-Hai Sea. The recent crisis in the Yellow River basin is complicated because natural climate fluctuation, global warming, change of land utilization, and water management may affect one another.

In this international workshop, interactions between atmosphere and land, and land and ocean in the Yellow River domain will be discussed. Three kinds of research plans in both Japan and China relevant to the Yellow River domain will be also introduced. Invited speakers will be from Chinese Academy of Science, Ocean University of Qingdao, and International delegates from BAHC and LOICZ of IGBP, and IAHS/IAPSO of IUGG.

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Implementation Plan of the Yellow River Studies
(Proposed at January 15, 2003)

Recent rapid change of water circulation in the Yellow River and its effects for environment, RIHN--Model development of surface water circulation in the Yellow River domain focused on water resources and water use, MEXT

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RIHN,Japan

Objectives:

Since 1972, the drying-up frequency of river water has rapidly increased in the Yellow River (called as Huang He in China) due to uptake of river water to irrigation farm in the midstream and downstream. In the lower reaches area of the Yellow River, living people suffers water shortage for irrigation, industrial and drinking water, and shortage of river open water induces drop of groundwater level and increase of water pollution. Chinese Academy of Science is now carrying out a synthetic national project from 1999 to 2003. By the increase of food demand, such a case seems to increase and to spread much more in near future worldwide. How can we recognize and resolve thus problem is the most important and urgent for human. In particular, China has a long cultural history more than four thousands years and might have faced to thus crisis many times due to climatic change. Nevertheless, the recent crisis in the Yellow River basin is complicated because natural climate fluctuation, global warming and change of land utilization may affect one another.

The above mentioned two research proposals aim at enhanced knowledge on planning countermeasures in the Yellow River drainage basin through the contribution from specific research fields under international collaboration with Chinese Academy of Science and IGBP/BAHC community. Finally, we wish to get how land use change affect to water cycle over the Yellow River drainage basin and what kinds of effect may occur by decrease of groundwater stages downstream to marine circumstance through five years research. Chinese scientists agree on collaborate studies with Japan by international frame basically. Through pre-project period in 2002, implementation research plan was discussed and brushed-up toward practical execution started at 2003. On the other hand, a new project plan in order to develop hydrological model for clarifying actual water use in agricultural field in the Yellow River domain was accepted by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). It continues from 2002 to 2006.

Through GEWEX/GAME project which has included continental-scale field Champaign of Tropics, Subtropics, Tibetan plateau and Siberia, the planner of this project has a lot of experiences through GEWEX(energy and water cycle experiment) and IGBP/BAHC(International Geosphere and Biosphere Program/Biospheric Aspect for Hydrological Cycle) Science Steering Committee.

Procedure to the study goal:

(A) Investigations

1) Observation and analysis of both energy and water fluxes from land surface to atmospheric boundary layer by using fluxes observation instruments, wind profiler and microwave water vapor radiometer in semi-arid region. In detail, the following study is now planned.

Implementation plan of Flux and ABL observation over Loess Plateau

Introduction (Purposes and Importance of Observation)

Loess Plateau region is recognized as relatively dry and high air pressure area during spring and summer season (Fukuta et al., 2002). Horizontal contrast of atmospheric water vapor content around the boundary of *Baiu* (*Meiyu*) front seems to affect for the activity of *Baiu* front itself. Study on variability of *Baiu* front activity is important to predict water resources in the eastern part of China (downstream region of Yellow River) and Japanese region. Thus real time data set of temporal variation of heat and water vapor fluxes (sensible and latent heat fluxes) in this region are important to predict the *Baiu* front activity in spring and summer seasons. Behavior of atmospheric boundary layer (ABL) will also affect for the *Baiu* front activity through the land-surface processes (exchange processes of sensible and latent heat fluxes). In additions, vegetation and/or land-use change will have impacts for the change of structure of ABL. Therefore it is necessary to measure the surface fluxes and ABL structures in Loess Plateau continuously.

The purpose of this study is to measure the sensible and latent heat fluxes, and the ABL structure over the Loess Plateau continuously (at least more than 3 years). Because knowledge of carbon balance over different land covers is necessary for future carbon balance in future, this study includes observation of carbon dioxide flux, simultaneously.

Method

Devices for the Observation

The following devices will be installed for the flux and ABL observations.

(1) Flux Tower & Meteorological Observation System

A flux tower and meteorological observation system, which planned to construct, is shown in Fig.1. 30-m height flux tower will be installed with strong basement. On the top of the tower, an ultrasonic anemometer-thermometer and an infrared H_2O/CO_2 analyzer will be equipped. Downward short-wave radiation, downward long-wave radiation, upward short-wave radiation, and upward long-wave radiation will be observed on the top of the tower. Profiles of air temperature, air humidity, and wind speed will be measured. Also measured will be ground heat flux, profiles of soil temperature and soil moisture.

The observed data should be collected using off-line PC around once / month.

(2) Wind (& Temperature) Profiler

Meteorological radar observation of wind speed, wind direction, and air temperature profiles will be carried out using wind (& temperature) profiler. The frequency for the wind observation is 1.3 GHz UHF wave. For the air temperature, radio acoustic sounding system (RASS) will be operated. The height range for the wind observation will be from 200 m up to 3 km, and that for the air temperature will be from 100 m up to 2 km from the ground surface.

The observed data will be transferred from observation point to Japan through Internet.

(3) Microwave Water Vapor Radiometer

Profiles of atmospheric water vapor content and air temperature will be measured using microwave water vapor radiometer. This device uses 3 main band of microwave from 20 to 70 GHz. The height range will be from 100 m up to 10 km.

The observed data will be transferred from observation point to Japan through Internet.

Requirement for the Observation

Totally 200 m^2 area (at minimum) will be necessary for the installation of the devices. The installation place has to be protected from the common people (for safety).

Electricity (AC220 V at 50/60Hz) is necessary for the operation of wind (& temperature) profiler and water vapor radiometer.

Observation Period

The observation will be started from May 2004. Because land use change and its impact for the precipitation system is one of the important issue, it is better to observe the flux and ABL structure as long as possible (at least more than 5 years).

Tasks and Required Data Set

Tasks

Chinese counter part researchers are kindly requested to maintain the flux tower system. The maintenance includes inspection of devices, data collection using note PC, and some manual observations (not yet determined).

Required Data Set

Radio-sonde (Chinese meteorological & operational) data are requested for the additional meteorological analyses. Atmospheric water budget analysis will be applied for the synoptic water vapor behavior. The stations for the radiosonde data will be Xi'an, Pingliang and Yan'an (Fig.2).

Arrangement of Staffs

- Chinese

Chinese researchers are requested to go and check the flux tower and profiler systems once / week, during operation period.

- Japanese

Japanese researchers will come to the observation station around once / two months after installation of the station. During establishment of the stations, Japanese researchers will stay continuously.

Expected Results

Continuous data set of surface flux and ABL structure will be obtained. The data set will be used for validation of land-surface parameterization and ABL parameterization of cloud resolving model. Entrainment parameters for cloud capped boundary layer, and for dry and wet convections are possible to estimate.

The observed long-term flux data is supplied for the AsiaFlux (Flux Network for Asian Country). This station is one of the important point for the AsiaFlux as a representative of Loess Plateau. Combined analyses using surface fluxes, ABL mean profiles, and satellite data set are probably possible to predict climate change and vegetation change over heterogeneous Eurasian continent.

Relations to Regional Climate Model

Radio-sonde data set, observed ABL structure, and observed fluxes will be used as input data for the regional climate model. The model is possible to estimate *Baiu* front activity with actual input data and hypothetical data. The observed data are possible to use for improvement of cloud resolving model, especially for the atmospheric boundary layer processes.

Contributions to AsiaFlux

The observed long-term flux data is supplied for the AsiaFlux (Flux Network for Asian Country). This station is one of the important points for the AsiaFlux as a representative of Loess Plateau.

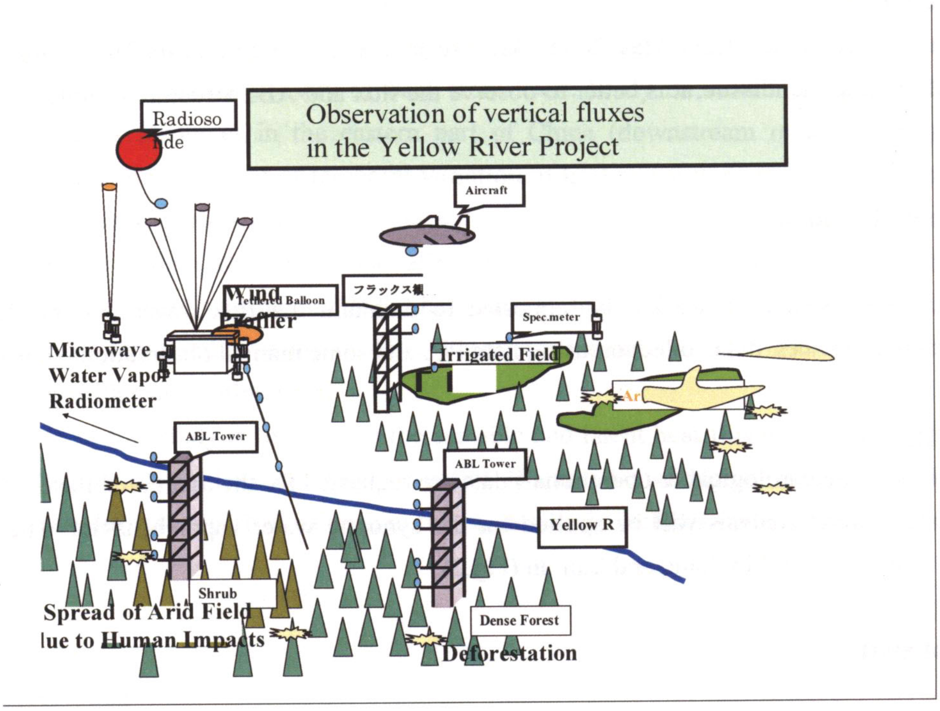


Fig.1 Schematic diagram of a flux tower and meteorological observation system.

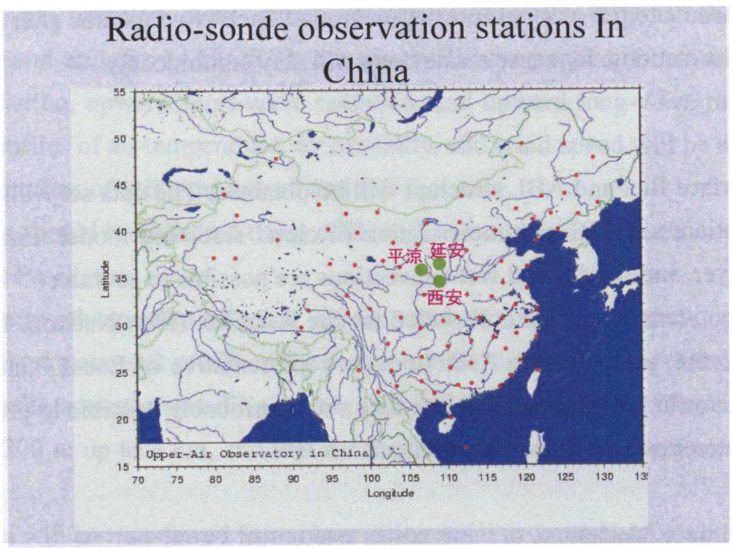


Fig.2 Upper air radio-sonde stations over China.

2) **Observation and analysis of groundwater flow to Bo-Hai Bay by using fiber thermo-radar and seepage meters**

The purposes of this study are;

(a) To evaluate the direct groundwater discharge rate and dissolved material transports into the Bo-Hai Bay,

(b) To evaluate the processes of material transports including nutrients discharge from the land to the ocean, and the process of re-circulated seawater in the coastal zone,

(c) To evaluate the interaction between Yellow River and groundwater, and then the effect of recent Yellow River cutoff on groundwater,

(d) To evaluate the origin and the causes of high salinity of the groundwater, and the interface between fresh water and saltwater.

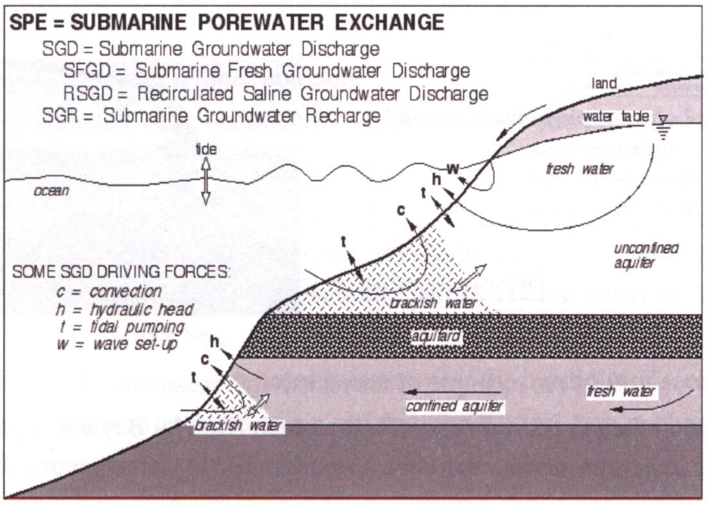


Fig.3 Interaction between freshwater and sea-water

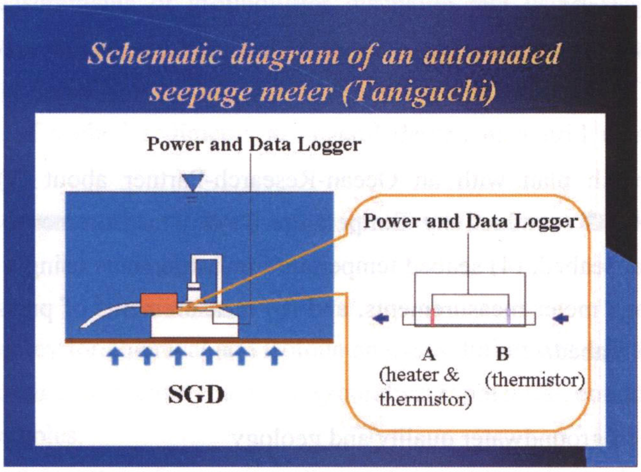
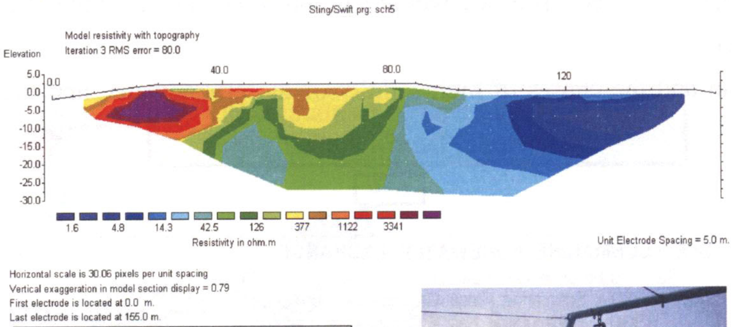


Fig.4 Schematic Diagram of an automated seepage meter



↑ an example of the resistivity measurements
Blue : Salt water
Red: Fresh water

Resistivity cables →

Fig.5 An example of the resistivity measurements

The researches will be held in the (1) coastal zone, (2), the ocean (Bo-Hai Bay and a part of Yellow Sea), and (3) the land.

<u>2002</u> (Feasibility Study)

(1) Coastal zone

(i) Decision of the location of the observation site to measure continuously groundwater discharge rate and dissolved material

(ii) Preliminary sampling of groundwater for chemical and isotope analyses

(iii) General survey for locations of the seepage meter measurement in Bo-Hai Bay and Yellow Sea.

(2) Ocean

(i) Making a research plan with an Ocean-Research-Partner about (1) Core sampling of seabed sediments (2) CTD (conductivity-Temperature-Depth) measurements of seawater, (3) Resistivity measurements at seabed, (4) seabed temperature measurements using a fiber optic temperature laser rader, (5) seepage meter measurements, and (6) measurements of pressure and temperature in pore water under the seabed.

(3) Land

(i) General survey of groundwater quality and geology

Collecting information of the locations of observation wells, groundwater salinity, geology and so on.

<u>2003</u>

(1) Coastal zone

(i) Evaluations of the saltwater-fresh water interface using "Resistivity sensors" at 3-4 observation lines (1km length, perpendicular to the coast) in (a) outlet of Yellow River, (b)south of Bo-Hai Bay, and (c) Yellow Sea. Continuous measurements using "Resistivity sensors" will be discussed.

(ii) Short-term evaluations of material transports into the Bo-Hai Bay at observation site; (1) Installations of water sampling devices and wells, (2) Sampling of discharged groundwater, (3) Sampling of soils for carbon, nitrogen, isotope measurements, (4) Sampling of groundwater, river water and soil water for chemical and isotope measurements

(2) Ocean

(i) Evaluations of the saltwater-fresh water interface offshore using "Resistivity sensors" at 3-4 observation lines (1km length) in (a) offshore of Yellow River, (b)south of Bo-Hai Bay, and (c) Yellow Sea.

(ii) CTD measurements in Ba-Hai Bay

(3) Land

(i) General survey of groundwater

(ii) Measurements of groundwater potential, electric conductivity and temperature at selected observation wells

(iii) Collecting the data of groundwater pumping

(iv) Resistivity measurements for identifications of the geology and groundwater salinity.

2004

(1) Coastal zone

(i) Continuous measurements of groundwater discharge rate using seepage meters at selected 3-4 locations (3 seepage meters in each location) such as (1) the outlet of Yellow River, (2) south of Bo-Hai Bay, and (3) Yellow Sea.

(ii) Continuous measurements of pore water pressure near the locations of seepage meter measurements.

(iii) Short-term evaluations of material transports into the Bo-Hai Bay at observation site; (1) Sampling of discharged groundwater, (2) Sampling of soils for carbon, nitrogen, isotope measurements, (3) Sampling of groundwater, river water and soil water for chemical and isotope measurements

(iv) Separation of net groundwater discharge with re-circulated seawater at observation site.

(2) Ocean

(i) Continuous measurements of groundwater discharge rate using seepage meters (which will be installed by divers from a Chinese boat, 3 seepage meters in each location) at selected 3-4 locations such as (1) the outlet of Yellow River, (2) south of Bo-Hai Bay, and (3) Yellow Sea.

(ii) Core sampling of seabed sediments at several depths in a grid mesh for chemical and isotope analyses.

(iii) Continuous measurements of pore water pressure at near the locations of seepage meter measurements.

(3) Land

(i) Groundwater survey for chemical and isotope analyses during wet and dry seasons.

(ii) Selections of continuous measurements of groundwater potential, conductivity and temperature in 10 observation boreholes.

(iii) Monitoring (for 2-3 years) of groundwater potential, conductivity and temperature along the Yellow river and at perpendicular to the river for evaluations of the effect of the recent Yellow River cutoff on groundwater.

2005

(1) Coastal zone

(i) Temperature measurements using a fiber optic temperature laser radar along the coastal line and the perpendicular to the coast in (a) outlet of Yellow River, (b)south of Bo-Hai Bay, and (c) Yellow Sea.

(ii) Continuous measurements using a fiber optic temperature laser radar will be discussed.

(2) Ocean

(i) Seabed temperature measurements using a fiber optic temperature laser radar and a Chinese boat

(ii) Core sampling of seabed sediments at several depths in a grid mesh for chemical and isotope analyses.

(iii) Measurements of pore water temperature at several depths near the locations of seepage meter measurements.

(3) Land

(i) Evaluations of the origin of groundwater salinity

(ii) Evaluations of the effect of Yellow River cutoff on groundwater

(iii) Evaluations of groundwater age

(B) Modeling works

1) Evaluation of water utilization by macro-hydrological model basically developed GEWEX/GAME Siberia
2) Evaluation of land use change by regional energy and water vapor circulation model basically developed by GEWEX/GAME HUBEX

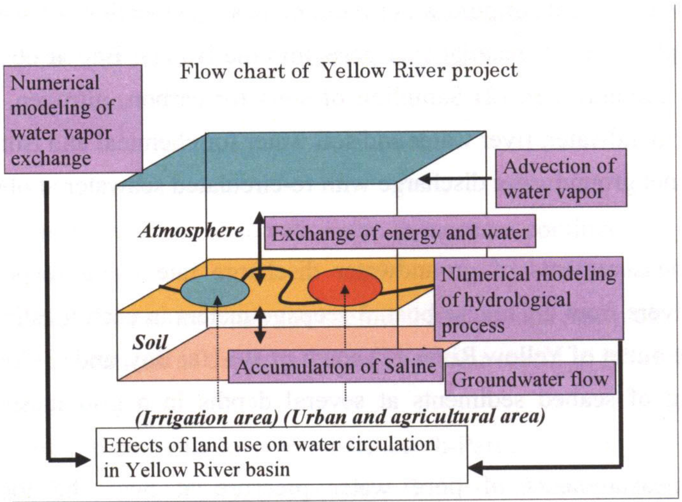


Fig.6 Flow chart of the Yellow River project

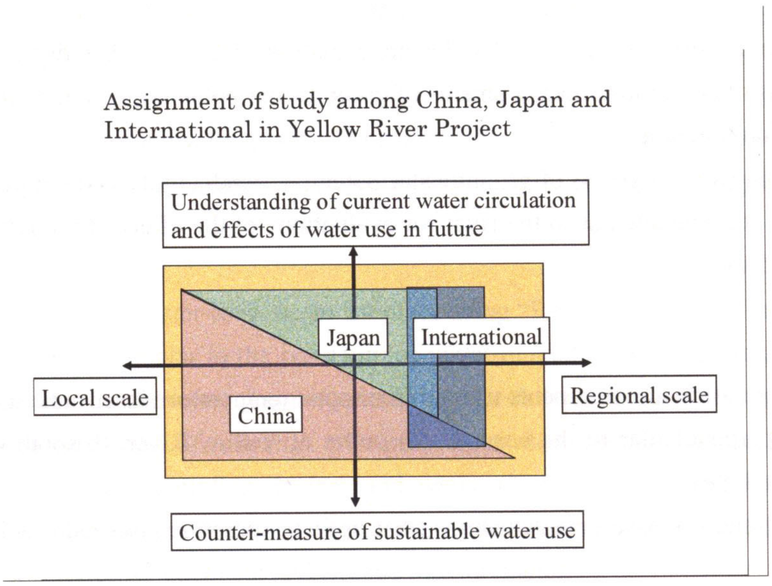


Fig.7 Assignment of study among China, Japan and International community in the Yellow River Project

On Evolutionary Laws & the Maintaining Mechanism of Reusability of the Yellow River Water Resources

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1. Research contents & significance

1.1. Background

The Yellow River has a vast valley area and historically it is the mother river of the Chinese nation. Now it serves as one of the main theatres for the on-going national campaign to develop China's western hinterland. As the majority of the landmass covered by the Yellow River Valley is dominated by semi-arid climate, the Valley's water resources are congenitally deficient as its water occupancy per capita is less than 1/3 of the national average. What is worse, frequent dried-ups in the lower reaches of the Yellow River mainstream occurred in the latest 30 years. The ominous development not only aggravates the fragile balance of the water supply in river basin areas, but also brings in new impacts on the native eco-system along the River's reaches. Historically, the River's harnessing used to be a state affair of vital importance for the national stability. Since the founding of the People's Republic in 1949, the country has achieved enormous success in this aspect. Yet, due to the predatory exploitation of the water resources and changes in natural conditions, the Yellow River is to face a serious and grim plight interwoven by intensified shortage of water resources, a higher and higher frequency of water-related calamities and the worsening situation of its eco-systems. This is the resultant consequence from the vicious development of the interaction between the River water-soil-ecosystem and the socio-economic system of man in the Valley. The shortage of water resources is the crux of the three curses now plaguing the River Valley. The formation, evolution and renewable capacity have their own self-governing laws. But the intensified human activities have infringed the original circulation of natural water and brought in remarkable changes to it, triggering acute tension in the normal supply of water resources in the Valley. As a result, a series of degenerative processes come into being in the environment and ecological balance. This is the main cause leading to the emergence of the three curses and becomes the bottleneck for sustainable development in the Yellow River valley. So the study on the evolutionary laws and the mechanism to maintain the renewable capacity of the water resources in the Yellow River basin becomes the critical factor and the strategic requirement of the whole nation in harnessing the muddy water of the River and introducing a sustainable development to the river basin areas.

1.2 Thinking approaches for the research project

The overall thinking approach is to give a precise and in-depth analysis of the formative factors of the water crisis in the Valley. By screening many S&T issues cropping out from the crisis, some key problems with fundamental significance are to be pinpointed. Based on the formative and evolutionary laws of the River water resources, new questions on renewable utilization and its maintenance are explored. Theoretically aligned by the water circulation and renewable capacity, a duality model on water resources is to be developed. Furthermore, under the theoretical guidance of the maintenance of renewable capacity and multi-dimensional and synthetic modulation of several critical values, the sustainable utilization of the water resources might be realized. In the same time, the changing mechanism of a water-and-silt process, the river flow withering mechanism and the formative mechanism which enables small floods to cause destructive calamity are to be deeply revealed. A series of workable measures for rehabilitating the Valley's depleted ecosystem and a waterway capacity to accommodate a flood has to be developed. In this way, a sound theoretical groundwork might provide for alleviating the water crisis, saving the ecosystem from further deterioration and control of the flooding calamities in the Valley.

Based on the above thinking approach, eight research topics are instituted, including dynamic mechanism and model of the Valley's water circulation, the evolutionary law and duality evolutionary model for the water resources, the fluvial functions and the transformation structure of the water resources in the River's lower reaches, the theory of renewable capacity of the River water resources and its evaluation, the change in the renewable capacity of the Valley's underground water, the feasible approaches for keeping the water resources renewable capacity and the multi-dimensional model for critical regulation. In combining the digital Yellow River tasks set for a project spearheaded by the Yellow River Water Conservancy Committee, methodologically, the project features both multi-disciplinary synthesis and inter-disciplinary hybridization. It borrows methods from earth sciences such as those from hydrology, science of water resources and geology / geomorphology, fluvial dynamics and systematic analysis and macroscopic decision-making from systems science and economics, as well as appraising analysis used in disaster reduction and environmental science. In the combination of the surveying data with simulation tests in labs, the project conducts the mathematical modeling based on the introduction of RS, GIS and GPS technologies. Through the marriage between analytic probes into micro-mechanical mechanism and macroscopic laws in regional geography, the assortment and integration of hydrological models to depict a unitary watershed or the whole Valley are to be realized.

2. Major Research advances so far having achieved

2.1 Phased advances in theory and methodology

1. In dynamic simulation of a water circulation, the project's tests have obtained results from

hundreds of runoff process experiments, developing a distributive hydrological model based on continuous and motive equations;

2. A theoretical model to depict the duality evolutionary laws of water resources in arid and semi-arid areas is constructed and via an analytic study on the characteristics of chaotic dynamics in the Yellow River's annual run-off volume at 100 year scale, a related quantitative model for defining the River's historical evolution was initially established;

3. Based on continuous real-time remote-sensing materials provided by NOAA/AVHRR during the period from 1981 to 1999, the changes in the spatial distribution and temporal dynamics of the Valley's annual evapotranspiration during the period are estimated successfully;

4. A group of preliminary results on the mechanisms governing the River's flood-accommodating capacity in its lower reaches and comprehensive influence on the fluvial functions when dried-ups of courses occur are obtained;

5. By employing the theory on the balancing the silt in the Valley, the influence of measures set for water-and-soil conservation on the Valley's silt transport ratio was probed;

6. A theoretical framework on the renewable capacity of the Valley's water resources volume was initially developed;

7. The concept and its types of the least water quantity for an ecosystem were defined and related computational methods were developed;

8. The first attempt in the country to classify the underground water systems in the Valley, solving the poser of numerical simulation on the movement of multi-layered groundwater aquifers and flows which contain water-saturated and unsaturated zones.

9. The refreshment, runoff and discharge of the groundwater in the Valley by using stable isotopes (^{2}H, ^{18}O and ^{13}C) and radioactive isotopes (^{3}H and ^{14}C) are achieved successfully.

2.2 Main staged advances in the project's applied basic research

1). The critical riverbed's specific drop in a silt-reducing ditch dug at the suspended river in the Yellow River's lower reaches is suggested, the feedback influence of the River estuary's evolution on tailing channels and the silt-carrying capacity of the suspended substance driven by the tide and waves at the River mouth are expounded, providing scientific grounds for harnessing the river channels in the River's lower reaches;

2). The least water volume needed for sediment transport from the River's lower reaches for the coming 20 years since the Xiaolangdi Reservoir has started its operation is estimated for prediction.

3). The relationship between the natural degradation of hydrocarbon pollutants in the water body of the Yellow River and rehabilitation of the contaminated water are revealed.

4). Via making clear the formative law of sloping gradients on the land forms of the Loess Plateau, the project works out scientific measures for recovering farmlands to forest- or grass-covered wilderness;

5). A system of parameters has been erected for evaluating the renewable capacity of the water resources in the Valley and the capacity was then evaluated in line with the new approach

6). The new thought "critical control" is first applied to the unified management and deployment of the water resources;

7). A study on the water quantity regulation model for the low-water season in the lower reaches of the Yellow River and the new model has been applied to the allocation and deployment of water resources in the Valley.

2.3 The establishment of related technical support systems

The project's achievements in this aspect include the elementary data base for the water circulation in the Valley, a databank for the socio-economic materials in the middle and lower reaches of the Yellow River, a databank for evaluating the renewable capacity of water resources in the Valley, a databank for the historical materials of water-and-soil conservation and land-use, the former including observational and on-the-spot surveying data obtained from more than 400 areas in 13 geographical zones while the latter containing 6,188 entries of information collected from 221 counties of Shaanxi, Shanxi, Gansu provinces, Ningxia Hui and Inner Mongolian autonomous regions. In line with the technical norms decreed by the information center under the Ministry of Land & Resources in 2,000, the groundwater databank was erected for the Yellow River Valley. Based on GIS, a management system on the basic databanks on the areas irrigated by Yellow River water in the River's lower reaches, capable of carrying out digital editing, searching and visual display and bringing in a platform for materials and data was established for the Valley's infrastructure.

3. Chief scientist in charge of the research project

Prof. Liu Changming, CAS member and director of the Joint Research Center on Water Problems under the CAS, Director of the Shijiazhuang Institute of Agricultural Modernization, Dean of the College of Resources & the Environment, the Beijing Normal University and Vice president of Geographical Society of China(GSC).

He had served as Chairman of the Hydrological Committee, GSC, Vice Chairman of the Forest Hydrology and Watershed Management, China Forestry Society, Vice President of the national committee under the International Association of Hydrological Science, Chairperson of the Study Group"Regional Hydrological Response to Global Change" under the International Geography Union (IGU), Chairman of China's national committee for IGBP/BAHC, member of scientific steering committee of IGBP/BAHC, Vice President of the IGU from 2,000 to 2004. Also, he now serves as an editorial member of both *Hydrological Processes* and the *International Journal of Water Resources Development* as well as editor-in-chief of China's *Acta Geogrpahica Sinica and Journal of Geo-Agricultur.*

Main achievements:

1. Prof. Liu has devoted his personal career to hydrology and water resources, one of the hot issues of today world's concern, by linking engineering sciences with earth sciences and thus forming the theoretical and methodological foundation for China's geographic hydrology and water resources research. In addition, he succeeds in developing research and teaching bases, a contingent

of talents in the CAS and Beijing Normal University such as the inauguration of a Joint Research Center of Water Problems, CAS and an Institute of Water Science and a key lab in Beijing Normal University.

2. In the surveying design of a railroad, he develops a model for computing the small watershed peak flows caused by the rainstorms so that the poser had been solved for the ungauged catchments. The formula was applied to the design of eight railroads including the Qinghai-Tibet Railway and the Line No. 101 in Xinjiang in Northwest China.

3. In the National Project of South-to-north Water Transfers, he suggested an analytic method for water diversion in a system of geographical hydrology, promoting the application of the theoretical methods on regional water and heat balance to water distribution and appraisal of the influence on the environment in the project.

4. In coping with the problem of farming irrigation, he developed a systematic theory on water-saving agriculture, enriching its disciplinary contents, and suggested a numbers of new ideas in this field.

5. He participated in the CAS-sponsored consultant projects under the titles of "On the way out for problem of China's water shortage" and "Countermeasures for alleviating the dried-ups in the Yellow River mainstream" and worked as partner of consultant projects sponsored by the CAE such as "A Strategic Study on Water Resources in China's Sustainable Development" and "A Study on Water Resources in Northwest China and Protection of the Eco-environment and Sustainable Development."

6. He hosted a research project under the title of "Water-saving Demonstration in Farming Undertakings & Sustainable Utilization of the Groundwater in Typical Hebei Plain Areas" a key R&D project initiated by the S&T Department of Hebei Province.

7. He so far has groomed more than 60 postdoc-graduates, has more than 200 monographs and research papers to his credit and won 12 prizes granted to him by national, provincial and ministerial authorities.

Regional Water Cycles and Society

Ehrhard Raschke

GKSS, CCSR, Germany

Our human society is becoming increasingly vulnerable to changes in branches of regional water cycles. But it possibly also contributes to their alterations due to increasing Greenhouse Gas Concentration and adding anthropogenic aerosols into the atmoaphere, to changes in land use and improper river management. The previous research initiatives within the GEWEX, concentrating on regional water cycles ,may become ideal testbeds for larger –scale studies of such impacts.

In this paper several research efforts and also the impact of recent floods in Europe are discussed introducing also into a new flood forecast system.

Global Perspective on the Water Balance and its Variability in the Huang He Basin

Taikan Oki, Shinjiro Kanae

Research Institute for Humanity and Nature, Kyoto, Japan
Institute of Industrial Science, University of Tokyo, Tokyo, Japan

Huang He River basin has approximately 750,000 km^2 of watershed and located in the Northern part of China. Mean annual precipitation is estimated as approximately 420mm/y and annual discharge at Sanmenxia station, which has drainage area of approximately 680,000 km^2, corresponds to 55mm/y. Therefore partitioning of precipitated water into evapotranspiration should be more than 85% on average. This dry regime of water balance infers the importance of irrigation for agricultural production, and the atmospheric water vapor divergence/convergence field shows divergence near the river mouth on annual time scale. It implies that the annual preipitation is less than annual evapotranspiration. Such a situation over land can be realized only by irrigation by either river water from upstream or ground water is put in the field for further evapotranspiration. Therefore evapotranspiration process should be relatively important for accurate estimates of water balance in the Huang He river basin rather than the runoff generation process in numerical models. Therefore land surface models (LSMs), which are believed to have better representation in evapotranspiration processes which couples energy and water balances, are expected to be used in the current project, and the LSMs will be coupled with river routing model (RRM). Irrigation model will be also developed and coupled with the LSM and the RRM. Uncertainties associated with the LSM and RRM, forcing data for LSM, model parameters, and the temporal and spatial scales used for estimations will be examined during the project. The impact of the irrigation activity on the regional climate through the feedback mechanism of land-atmosphere interactions will also be investigated.

An assessment of the Impact of Climate Changes on the Hydrological Budget over the Yellow River Domain

Akiyo Yatagai

Research Institute for Humanity and Nature,Japan

The YR domain is geographically sub-divided into the three sub-regions, namely over the Tibetan Plateau, the Loess Plateau and the lower reaches of the river. The climate system of the regions are affected by both mid-latitude and monsoon circulations. The mid and lower reaches of the river are located in the eastern most part of the mid-latitude arid zone, called Silk Road (Turkey/Central Asia/North China), where the arid climate was made by the existence of the gigantic mountain, the Tibetan Plateau (Yatagai, 2003). Therefore, in order to study the impact of climatic (natural) variabilities to the environment of the YR, we should remark the influences of the monsoon circulation, especially around the Tibetan Plateau, and also mid-latitude circulation to the regions. In fact, it has already pointed out that the summer precipitation over the Loess Plateau shows positive correlation with the Indian monsoon rainfall, and it tends to be dry (less precipitation) in EN/SO years (Wang and Li, 1992; Yatagai and Yasunari, 1995)

Investigating the hydrological budget estimated by the ECMWF reanalysis for the three sub-regions (see above) for 1979-1993 with the test product of precipitation (Xie, 2002), some points are shown at the workshop. We got consistent relationship in the time series for hydrological balance computed both by atmospheric water balance method of the ECMWF re-analysis and surface model flux by the ECMWF data, and precipitation data over the Loess Plateau. A sample composite pattern of the precipitation and the water vapor transport in the wet/dry years is given in Fig. 1. In the wet (relatively much rainfall) July for the Loess Plateau, more rainfall is also observed in the northeast India, and Taklimakan Desert, which implies stronger monsoon circulation around the Tibetan Plateau. It is also consistent with the result that in wet years Loess Plateau receives more water vapor flux from the south (Yatagai, 2003). In contrast, over the lower reach of the river and over the Tibetan Plateau, time series of moisture budget and forecasted fluxes do not show well consistent behavior each other. It should be investigated carefully with land surface modification, land surface processes including bio-physical effects, also change of input data.

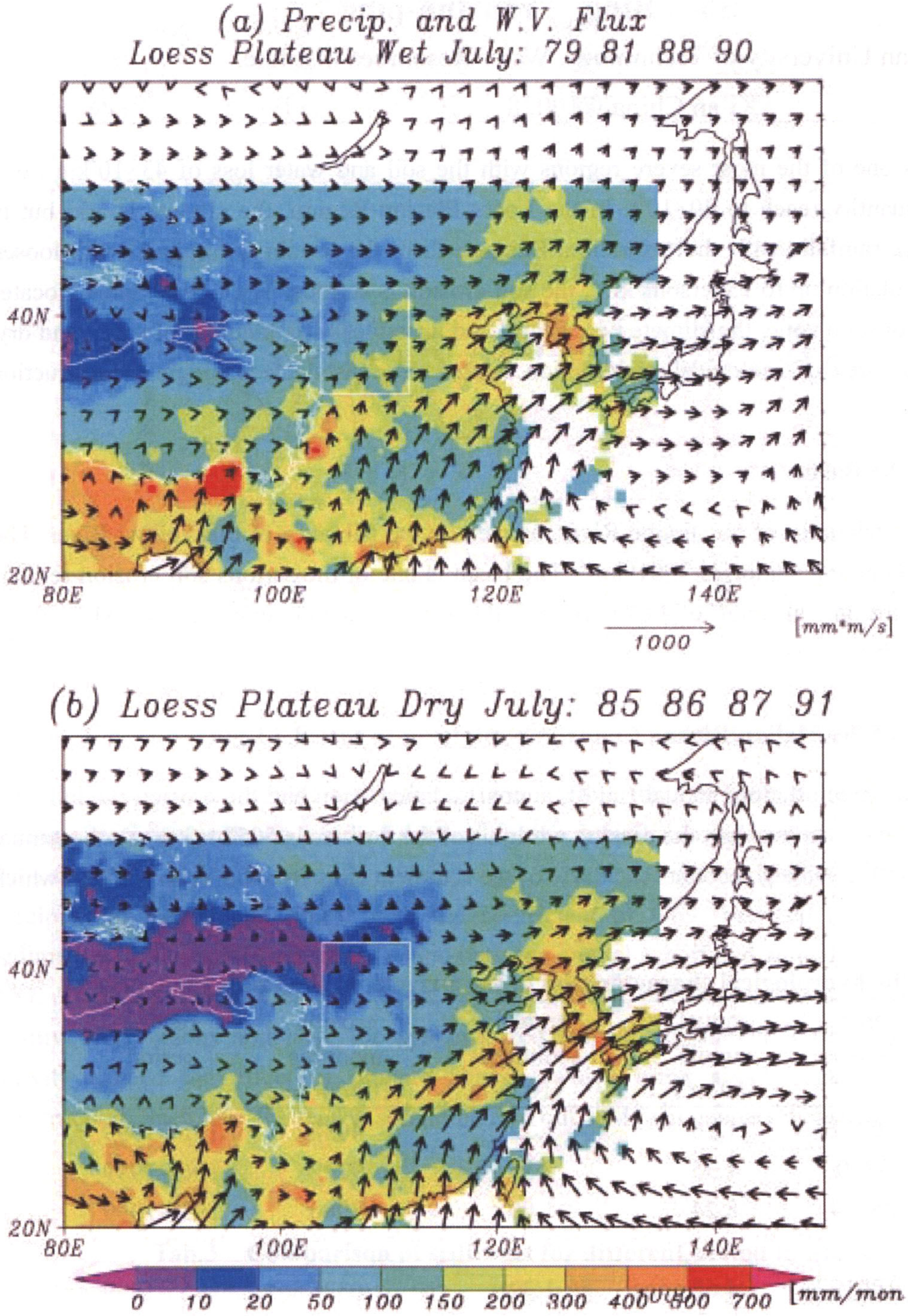

Figure 1 Water Vapor Transport of the Wet/Dry years for the Loess Plateau overlapped with the composit precipitation (Xie, 2002) for July. Selected years are given in the diagram. Vectors show vertically integrated moisture transport (unit: mm*m/s) computed using ECMWF reanalysis data, and color indicates precipitation in mm/month.

Hydrological Change of the Malian River

Shen Bing, Yan Jun-ping

Xi'an University of Technology, Water Resources Institute,

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The Loess Plateau is one of the most severe regions with the soil and water loss of $43\times10^4km^2$, e.g. every year the soil loss quantity reach to 40×10^8t. In the Loess Plateau Region, the climate is arid but in summer there are intensive rainfalls with short duration. Because there the terrain is fragment with loosen surface soils and dens population up to 73persons/km^2, the soil erosion is serious. The Loess Plateau locates at the edge of East Asia monsoon zone, the climate here is arid and unstable, with the trend of warm and dry. And the district is the key area of ecological construction region; the reasonable ecological construction strategy is needed urgently.

1 General Situation of the Basin

The Malian River is a tributary of the Jinghe River, as well as the tributary of the Yellow River. The control area at Yuluoping Gauging station is $19019km^2$. The basin is one of the serious soil erosion regions on the Loess Plateau, with the annual runoff of $4.673\times10^8m^3$, the annual sediment exported of 1.317×10^8t, the erosion modulus of $9625t/(km^2\cdot a)$。

2 Hydrological Change of the Malian River

Table 1 lists the annual precipitation, annual runoff, annual sedimentation and the erosion modulus for the 5 rivers on the Loess Plateau. In average, the erosion modulus of the 5 rivers is 5058 $t/(km^2\cdot a)$, the annual sediment exported is 4.67×10^8t, which accounts to 58.4% of the sediment flow into the Yellow River, which is 8×10^8t.

Tab.1 The hydrological characteristics of the 5 rivers on the Loess Plateau

river	gauge	area (km^2)	annual runoff (10^8m^3)	annual sediment (10^8t)	erosion modulus ($10^4t/km^2\cdot a$)	record period
Wuding	Chuankou	30217	12.0	1.22	4038	1957-1999
Yanhe	Yan'an	3820	1.35	0.35	9222	1965-1999
North Luo	zhuangtou	25154	8.24	1.00	3980	1939-1999
Malian	Yuluoping	19019	4.67	1.32	6825	1955-1999
Jinghe	Yangjiaping	14124	7.31	0.787	5571	1956-1999

Since 1950's, the hydrological regime of the 5 rivers have been changed a lot. In table 2, the comparison is made between 1960's and 1990's for precipitation, runoff and sediment. From Tab.2 and Fig.1, it can be seen that the decrease of precipitation for the 5 basins is not evident, the decrease of runoff is evident, the sediment exported in first 30 years decrease continuously, but in 1990's it increase significantly.

Tab.2 Hydrological change of the 5 rivers on the Loess Plateau

period	1960-1969	1970-1979	1980-1989	1990-1999	60's/90's
precipitation(mm)	538.8	474.3	491.3	433.7	0.805
runoff(10^8m^3)	43.48	43.38	30.64	26.48	0.609
sediment(10^8t)	6.14	4.32	3.02	4.99	0.733

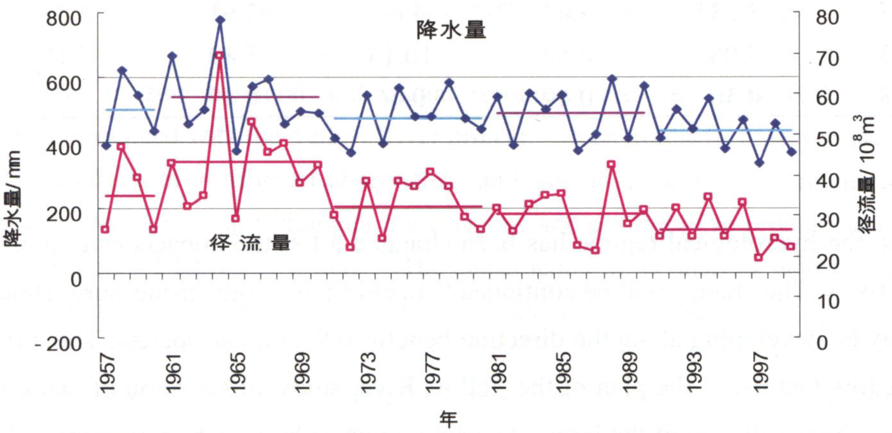

Fig.1 Change of precipitation, runoff and sediment of the 5 rivers

The precipitation, runoff and sediment are listed in table 3. From tab.3, it can be seen that the annual average precipitation has a trend of decreasing, the annual runoff fluctuation has a trend of increasing, but the sediment reach maximum in 1990's. And there exist some significant correlations between annual precipitation and annual runoff with the coefficient of 0.69, between annual precipitation and annual sediment with the coefficient of 0.48, and between annual runoff and annual sediment with the coefficient of 0.87. All the correlations reach the t-test with significance of 0.001. It is shown that the three correlations are positive correlations and have the synchronized feature. In Malian River Basin, the impacts of human activity exceed the effect of climate change, which bring about negative impact on the ecological construction. Such that, the reason should be find out, and then counter-measures should be established.

Tab.3 Comparison of sediment for different period in Malian River Basin

Item	1960-1969	1970-1979	1980-1989	1990-1999	Average	Ratio 60/90
precipitation (mm)	601.2	514.3	543.3	481.6	535.5	0.895
runoff (10^8m^3)	4.82	4.36	4.84	4.75	4.67	1.040
Sediment (10^8t)	1.37	1.20	1.04	1.63	1.32	1.144

If taken the runoff which may carry 10^8t of sediment as the index of sediment production, then the sediment production of the Malian River and the other four rivers are compared in Table. 4.

Tab.4 Sediment production of Malian River and other four rivers

river	1955-1959	1960-1969	1970-1979	1980-1989	1990-1999	平均
Malian	3.17	3.53	3.64	4.67	2.91	3.55
Other four	5.43	7.08	7.50	10.14	5.89	7.18
Ratio	0.58	0.50	0.49	0.46	0.49	

3 Conclude

Since the 1950's, the hydrological regime has been changed a lot, the impacts caused both by climate change and human activity. The change will be continued henceforth, the counter-measures should be studied, so that the change may be developing along the direction benefit to the human society. The difficult problem lies in distinguish the tow factors. In the plan of the Yellow River study, observation of vapor flux is one of the items in the study, which will benefit the large scale simulation of hydrological processes. It is suggested that the simulation should be forward step by step, which means that the simulation begin from the Malian River Basin, and then to the Weihe River, finally to the middle reaches of the Yellow River. On these bases, the factors which cause the impacts can be distinguished, the counter-measures proposed can be reasonable.

Techniques For Objective Precipitation Analyses and Their Potential Applications in the Yellow Revier Project

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Precipitation analyses of fine temporal and spatial resolution are very important for many research and development works associated with the Yellow River project. Such products, however, are not readily available due to the combined effects of insufficient observations and lack of apporpriate techniques to create the analyses from such input data. Most existing techniques are designed and developed to produce analyses of precipitation with a resolution of daily / 1°lat/lon or lower. The construction of an analysis with higher resolution requires the use of satellite estimates and gauge observations from high density networks.

Work is underway in NOAA/CPC to develop a new technique to create analyses of daily precipitation on a 0.25°lat/lon grid over the globe by merging gauge observations and estimates derived from satellite observations of IR, TOVS, SSM/I, and AMSU-B. In this technique, a 3-step approach is applied to reduce the bias and random error inherent in the individual input data sources. First, bias correction is conducted for each satellite estimates by comparing them with 'reference' fields over an accumulated period. The 'reference' field is the GPCP pentad merged analysis over oceanic areas, while over land areas it is the gauge observations. The second step of the algorithm combines the bias-corrected satellite estimates to reduce the random error through the Maximum Likelihood Estimation method, in which the weighting coefficients are inversely proportional to the error variances. The combined satellite estimates are finally merged with gauge observations to improve the accuracy over regions where dense gauge networks exist. Fig.1 shows an example of a test version of the daily analysis for August 1, 2001.

Construction of such a high-resolution analysis, however, is only possible for the period after 2000 when satellite estimates in high resolution became available. In considering the potential requirements for the daily precipitation analyses and the availability of the observation data, the author proposes to create a suite of products of daily precipitation for the Yellow River Project:

1) A standard analysis of daily precipitation on a reasonably good resolution (0.5/1.0°lat/lon) over an extended domain for an extended period based on gauge observations;

2) A regional analysis of daily precipitation with high resolution (0.1°lat/lon) and high quality over the target domain for an extended period based on gauge observations from GTS and special collections;

3) A merged analysis of daily precipitation on high resolution (0.25°lat/lon) over the extended domain but for a recent period when high resolution satellite estimates are available; and

4) A derived analysis of daily precipitation on 0.1° lat/lon resolution derived from the standard analysis but with no quality guarantee;

The success of the products relies heavily on the availability of gauge observations over China. Especially, gauge reports from additional stations over the target domain around the Yellow River basin are indispensable to the improved quality and therefore the usefulness of the precipitation analyses.

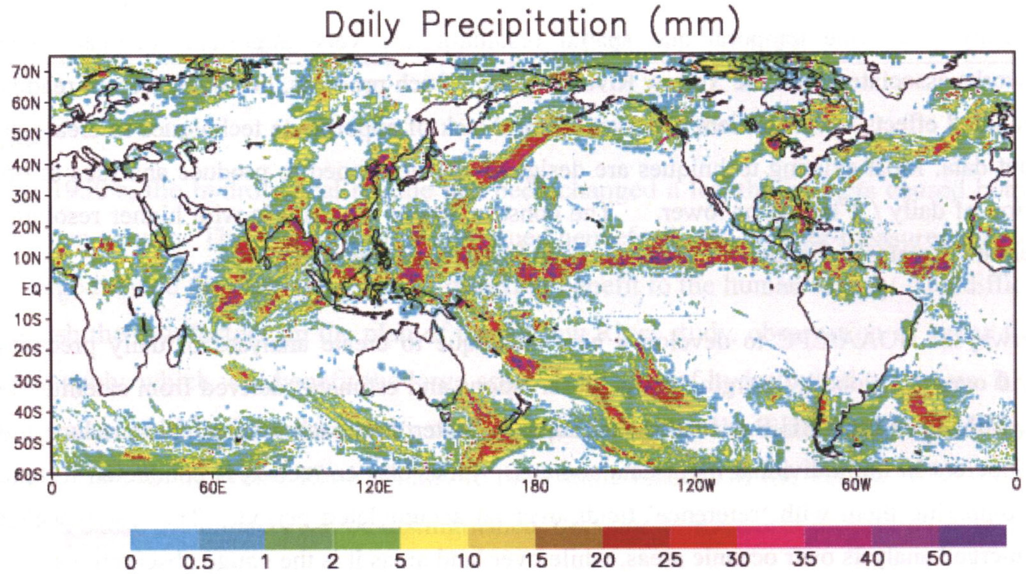

Fig.1 Analysis of daily precipitation (mm) for August 1, 2001, produced by a test veresion of the OI-based merging algorithm.

Radiation Budget Studies in the Yellow River Basin

Tadahiro Hayasaka, Kazuaki Kawamoto and Nobuyuki Kikuchi
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Shortwave and longwave radiation budgets are important for evaluating the energy and water cycles on the earth's surface. Large scale data with high resolution of 10 km are needed for the Yellow River project. Utilization of satellite data, particularly of cloud, is indispensable for this purpose. It is also suitable for the project because some of the satellite data are available for the last two decades. For example, ISCCP DX data are available, in which surface radiation budgets are 1 degree by 1 degree and daily although the archived period is limited. Therefore, some new improvements are needed for 10 km spatial resolution even if the radiative transfer technique is applied to cloud and other atmospheric data for estimating surface radiation budgets. On the other hand, direct measurements of radiation on the ground surface are quite poor to cover the whole Yellow River basin so that those measurements are used to validate results estimated from satellite remote sensing. Most of shortwave radiation measurements are sunshine duration in China. Statistical approach may be useful to merge these ground based measurements and satellite data. The status of satellite data such as ISCCP and some example of statistical approach to compare the satellite data and ground based measurements will be introduced and discussed in the workshop.

An Analysis of Energy and Water Balance through Routine Meteorological Datain the Yellow River (Huanghe River) Valley

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A model with its input data derived from routine meteorological data has been used for estimating heat and water balance in China including the Yellow River (Huanghe River) Valley. Soil-water transportation through vapor and liquid phases under the ground surface has been considered in the model. Calculated results have been verified by the observed heat fluxes, soil-water observation results, and observed surface temperatures (Kondo and Xu 1997, Xu and Haginoya 2001). Daily and seasonal variations show good or reasonable agreements between the calculated and observed results.

Solar and longwave radiations, latent and sensible heat fluxes, surface temperatures, evaporation, corrected precipitation, soil-water contents, etc., can be output by the model. For example, we estimated that from northwest to southeast in the Yellow River (Huanghe River) Valley, annual solar radiation flux (estimated from sunshine duration.) changes from 220 Wm^{-2} to 140 Wm^{-2}. Annual effective longwave radiation flux (estimated from solar radiation flux, air temperature, and air humidity) has a range from 80 Wm^{-2} to 50 Wm^{-2}.

On the other hand, climatic variation over Eastern Asia including the Yellow River (Huanghe River) Valley, were analyzed using meteorological data for 32 points in the period 1971 to 2000. Changes in heat and water balances were examined using potential evaporation. Climate zones in Eastern Asia identified by the wetness index matched well with the distribution of vegetation.

At a station in semi-arid region such as Lanzhou, the sensible heat flux is found to be considerably greater than the latent-heat flux during the dry season. Both fluxes, however, have comparable magnitudes during the rainy season. The annual mean value of the soil-water content increases with depth, and the rate of increase grows larger as the amount of annual precipitation increases. But for an arid station, the profile of annual mean value of soil-water content does not increase with depth and the soil-water evaporated from the soil surface during the day and came back to the soil surface at night. At a station having a snowfall during the winter, the ground-surface temperature begins to rise just after the disappearance of the snow cover. Consequently, the sensible and latent heat fluxes increase abruptly from negative values to positive values. Soil-water content becomes abundant due to the melted snow.

It is found that the annual amount of evaporation depends on the annual amount of precipitation. That is, in the arid region, it is proportional to the annual amount of precipitation. On the other hand, in the humid region, it tends to have a limited upper value, determined as functions of the potential evaporation and soil or vegetation types. In arid and semi-arid regions, a greater portion of precipitation from rain events is lost to evaporation within a few days after rainfall, so water resources become scarce. For a region having a snow cover during the winter, however, a considerable amount of melted water formed in the spring, resulting in a remarkable contribution to water resources.

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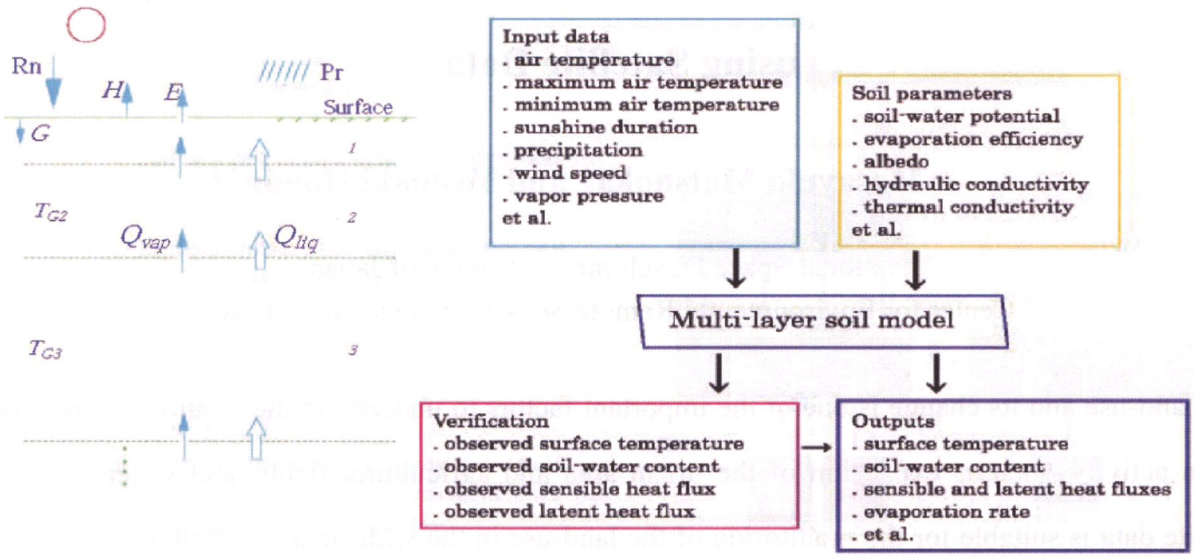

Fig.1. Outline of the soil model.

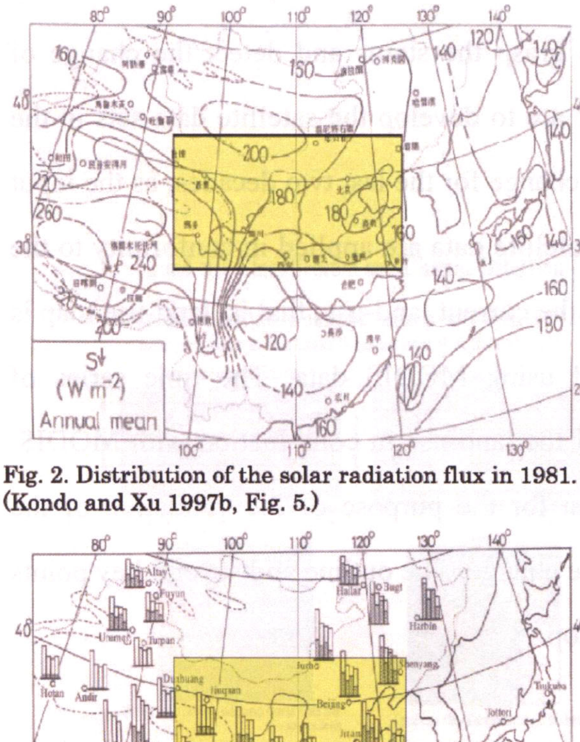

Fig. 2. Distribution of the solar radiation flux in 1981. (Kondo and Xu 1997b, Fig. 5.)

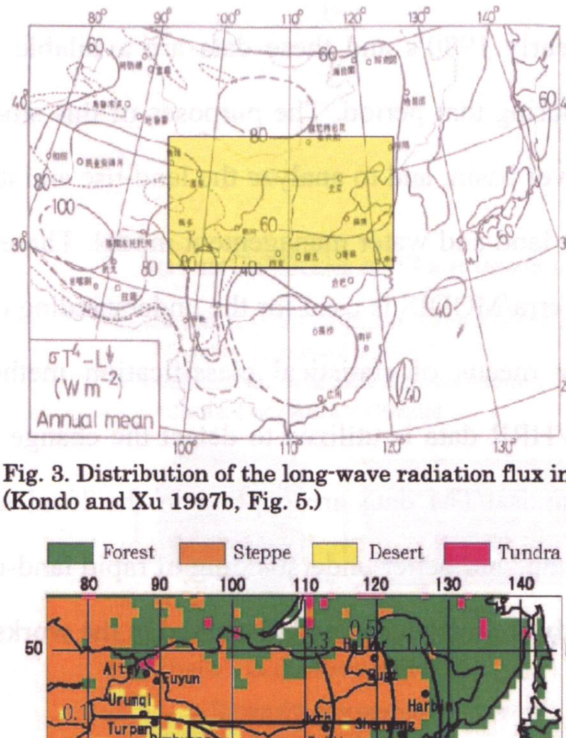

Fig. 3. Distribution of the long-wave radiation flux in 1981. (Kondo and Xu 1997b, Fig. 5.)

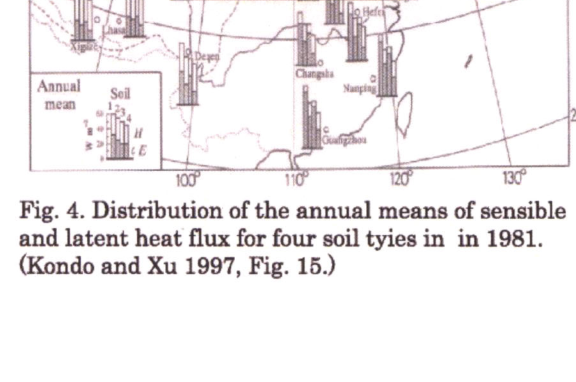

Fig. 4. Distribution of the annual means of sensible and latent heat flux for four soil tyies in in 1981. (Kondo and Xu 1997, Fig. 15.)

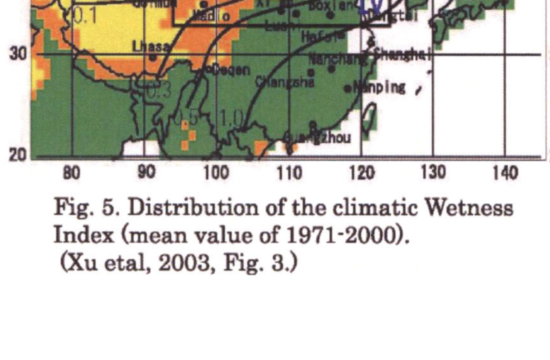

Fig. 5. Distribution of the climatic Wetness Index (mean value of 1971-2000). (Xu etal, 2003, Fig. 3.)

Research Plan of Land-use Change Analysis in Yellow River Basin using Satellite Data

Masayuki Matsuoka* and Yoshiaki Honda**

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* Center for Environmental Remote Sensing, Chiba Univ., Japan

Land-use and its change is one of the important factors to understand the relationship between human activity, such as expansion of the urban area and agricultural fields, and water resource. Satellite data is suitable for the monitoring of the land-use in the wide area like Yellow River basin from the viewpoint of its spatial and temporal scale. Several satellites are operated successively from the early 1980's and these data are available to grasp the status and detect the change of land-use during that period. The purposes of this study are to develop the satellite data sets in the Yellow River basin, and to analyze the land-use and its change for the last two decades, as the input data of the land and water management model. Three satellite data are applied in conformity to the purpose. Terra/MODIS is used for the understanding of the current land-use, that is, land-use map is created by means of statistical classification method using MODIS data. The time series of NOAA/AVHRR data is utilized to detect the change of the land-use in combination with MODIS. Several Landsat/TM data are applied in the local area for the purpose of the validation of the land-use map, and better understanding of rapid land-use change. The outline and several key points of this study are introduced and discussed in the workshop.

Background and Objective

* Land-use is one of the important factors of the land -water management model.

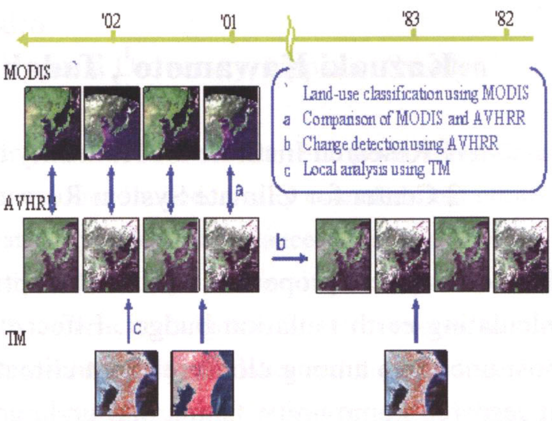
* The historical relation of land -use change and water use is essential to the water resource prediction.

* Remote sensing is suitable for land -use monitoring.
  > Wide area observation
  > Long term archive of data

For the purpose of development of land -water management model.
* Production of satellite dataset of Yellow River basin for last 20 years.
* Analysis of land -use change for that period.

a

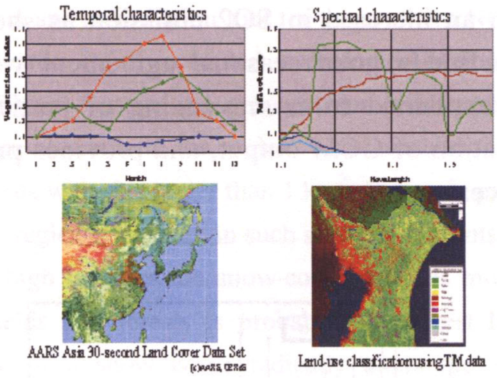
Production of Satellite Data Sets



b

Land-use Classification and Change Detection

Statistical classification using the characteristics of the surface.
(reflectance, brightness temperature, vegetation index, NDR, BSI etc.)



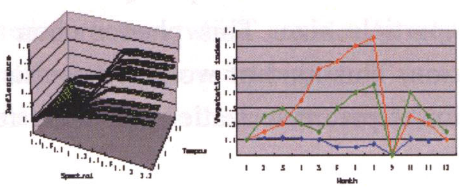
AARS Asia 30-second Land Cover Data Set

Land-use classification using TM data

c

Land-use Classification and Change Detection

1. Construction of spectral and temporal database of land surface.
   * Deviation of data should be included.
2. Classification based on the statistical distance criterion.
   * Cloud and snow should be eliminated.



3. Change detection by direct comparison of the characteristics.
   * Similar to the classification methodology.

Distortion of the sensor sensitivity should be considered.

d

Cloud properties derived from satellite remote sensing and their relationships with other factors in East Asia

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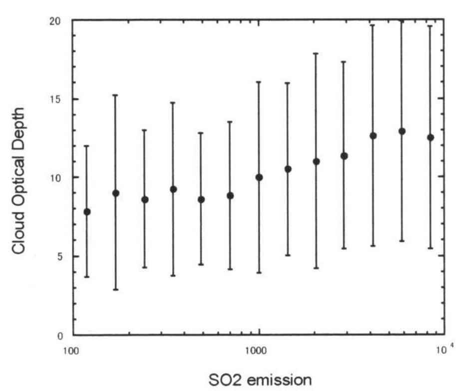
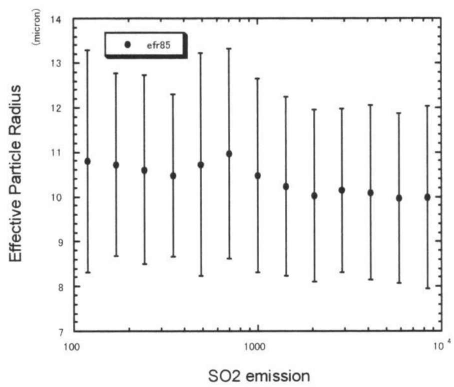
2 Center for Climate System Research, The University of Tokyo, Tokyo, Japan

The cloud optical properties such as the optical depth and effective particle radius are important for calculating earth radiation budget. Effect of cloud modification or cloud-aerosol interaction is the most uncertain among cloud-relevant climatic issues. It has been one of the hottest topics in our recent research community. China had undergone substantial political changes since early 1980's, and then subsequent social and economical effects have drastically increased in industrial production and the number of car and so on. With this background, we examine the variability of cloud properties which were derived from AVHRR (Advanced Very High Resolution Radiometer) data to study the effect of industrial growth on clouds in the East Asia. We have analyzed 10-year data from 1985 to 1994, and found gradual decreases in the effective particle size for both oceanic and continental clouds. Although a part of decrease in the particle size might be due to additional pollution for this area, there are, however, several causes to bring artifacts in the retrievals such as sensor degradation, discontinuity of platform and orbital shift. So considerable efforts should be addressed to reduce the artifact. Also we compare the cloud properties with SO2 emission and precipitation amount. As for SO2 emission, the results support Twomey effect, indicating that larger optical depth, smaller particle size are observed with an increase in SO2 emission as shown in figures below. And as for precipitation amount, we find a good seasonal agreement with the effective particle size. This phenomenon would be explained from scavenging of particles by precipitation. This kind of work is important for validation of GCM output, and provides precious information to parameterizations on cloud-relevant processes.





The NOPEX project, experiences and scientific results

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NOPEX is devoted to study land-surface-atmosphere interaction in northern European forest-dominated landscapes. Equal weight is put on long-term measurements and time-limited, areally extended field efforts. Data are collected both on energy (micrometeorological) and water (hydrological) balances. The two NOPEX study regions represent the southern (Uppsala, Sweden) and northern (Sodankylä, Finland) parts of the boreal zone, situated in the Baltic Sea drainage basin. NOPEX specifically aims at investigating fluxes of energy, momentum, water, and CO_2 between the soil, the vegetation and the atmosphere, between lakes and the atmosphere as well as within the soil and the atmosphere on local to regional scales ranging from centimetres to tens of kilometres.

Gottschalk *et al.* (1999) compare fluxes of sensible and latent heat over the southern NOPEX region calculated with five methods (airborne and balloon-sounding measurements, weighted mast measurements, and two models) and found rather large differences between some of them. The aircraft measurements of sensible heat fluxes were generally lower than those obtained from ground measurements whereas latent heat fluxes showed a fair agreement. Good agreement was found between all the different methods when it came to evaporation fluxes. This indicates that evaporation fluxes can be aggregated from land-use-weighted mast fluxes in this boreal-forest region. Frech & Jochum (1999) evaluated flux-aggregation methods from aircraft measurements and found different behaviour for momentum and scalar transfer. It seems as if the momentum transfer is governed by the roughest elements (the forest) whereas the sensible heat flux is determined by the predominant land-cover type in a given grid cell or aircraft run segment. The ECOMAG hydrological model was further developed as a combined prediction and assimilation tool for the southern NOPEX region (Motovilov et al., 1999) and was used as a first step towards a fully coupled hydrological-atmospheric model. Beldring et al. (1999) found that measured soil-moisture content and groundwater levels show a characteristic pattern which are closely related to the landscape elements in the region. The variability of average values between areas decreases to a minimum for catchments with size larger than 1 km^2. The main part of the spatial variability in the forest-covered till soils of the NOPEX region was found in such small catchments.

The high latitudes are snow-covered for as much as nine months of the year. The difference between open snow fields and forests is probably the largest land-surface contrast found in the terrestrial biosphere. The presence of a snow cover radically alters the surface radiation budget, changes the surface aerodynamic characteristics and insulates the ground, preventing very cold air temperatures propagating into the soil. Transpiration rates are small during winter, because of cold, often frozen soils. In spring, a substantial solar radiation input to the canopy is balanced by a substantial upward sensible heat flux (Gryning *et al.*, 2001). A comparison between surface and aircraft observations, and numerical simulations (Savijärvi & Amnell 2001, Melas *et al.* 2001, Batchvarova *et al.* 2001) showed good agreement. These studies also illustrate the high sensible heat flux from the forested areas, leading to the development of a convective atmospheric boundary layer. The importance of the snow model within a NWP model is illustrated in Savijärvi & Kauhanen (2001). Night-time air temperatures were under-predicted by between 12 and 15°C in their study and the thermal snow-surface properties appeared crucial for this. All these studies show the importance of the snow-vegetation-atmosphere interface to the atmosphere. The improvements in the parameterisations of the fluxes across this interface substantially improved the simulations of the atmospheric boundary layer and will likely lead to improved performance of NWP and climate models in high-latitude regions.

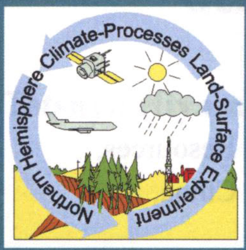
References in the abstract refer to the following three publications:

Halldin, S., Gryning, S.-E., Gottschalk, L., Jochum A. A. van de Griend., Boreal Forest and Climate, NOPEX Special Issue. *Agricultural and Forest Meteorology*. Vol. **98-99**., 1999

Halldin, S., Gryning, S.-E., Lloyd, C.R., Land-surface/atmosphere exchange in high-latitude landscapes. NOPEX/LAPP Special Issue. *Theoretical and Applied Climatology*, vol **70**, No. 1-4, 2001.

Boundary-Layer Meteorology, Vol. **99**, No. 3, 2001

The NOPEX project
Experiences and scientific results



Sven Halldin, Department of Earth Sciences
Uppsala University, Sweden

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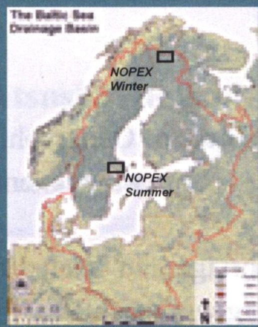
Geographical setting



- Mesoscale land-surface experiment in the Baltic Sea drainage basin
- Representative for the boreal-forest zone in northern Europe

2003-01-29 International Workshop on Yellow River Studies 2

Objectives

- To investigate fluxes of energy, momentum, water, and CO_2
- at scales ranging from centimetres to tens of kilometres
- in order to establish daily and annual budgets of water and energy budgets
- and to analyse and model the land-surface-atmosphere interface

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Flux-aggregation conclusions

- Forests dominate regional fluxes of momentum and sensible heat, but in different ways
- Regional evaporation can be modelled as simple land-use-weighted local fluxes
- CO_2 fluxes can be accounted for by boundary-layer budgeting if free-air concentration is known

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Experiences

- Longterm, unbroken measurements from representative landscapes are very valuable
- Closure of energy and water budgets require both traditional hydrological and micrometeorological/boundary-layer data
- Measurements and modelling are siamese twins, neither lives well without the other
- Be critical to models developed for other soils, vegetations, landscapes and climates

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Experiences, continued

- Publication strategy and plans should be clear already at the beginning of the project
- Database strategy, incl time schedule for delivery of data and metadata, and final publication/release of data should be clear at the beginning of the project. As part of traditional publication it gives merits to the "author"

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Water Security Problem Impacted by Climate Change and Human Activity in North China

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Chinese Academy of Science, Beijing, China,

The issue of water shortage and related eco-environmental degradation in the North China is one of the major emergency problems in China. As runoff generated from mountain area is significant decreased and over developing water resources, it result in serious water and eco-environmental problems, such as drying-up of river system, ground water decline, lake & wetland degradation, and water pollution in plain area etc. It was shown in the case of Haihe River Basin that among the total rivers of 10,000 km, the rivers of 4,000 km have been turned to be seasonal rivers. Comparing with the beginning of 1950s, the wetland area within the Basin decreased from 10,000 km^2 to 1,000 km^2 at present. Over-extraction of groundwater, this area covers nearly 90,000 km^2, 70% of the plain areas. Comparing with that of the end of 1950s, the accumulated over-extracted groundwater is 90 billion m^3. Water and soil loss area in mountainous region : 110,000 km2, rating two thirds of the mountainous area. The sandstorms induced by desertification endangering Beijing and other cities. Thus, the problems of water shortage and related eco-environmental issues in North China have become the most significant issue to impact sustainable development in this very important region that are political, cultural and economic center of China.

This paper addresses these emergent issues by the case study of Haihe River Basin in North China. The new advantage on water international study and background of causing these problems from natural change and particular human activity are analyzed. Key points are addressed as four aspects:

(a) the study of the water cycle process impacted by climate change and high intensity human activity, where climate change influence on continue drought in this region was addressed, and human activity was discussed,
(b) water utilization related to new economic partner change, such as saving water model,
(c) study on eco-hydrology, and interaction of water and ecology impacted by climate change and human activity,
(d) reasonable water allocation that including Water Diversion from South to North and saving water issue in local areas.

Several suggestions of both study on the water cycle, which is a very important base of water security in North China, and application study of water resources and eco-environmental rehabilitation are proposed. These key issues will benefit to both advantage of water science and sustainable developing in China.

Key words: climate change, water security, North China, environmental change

Research Plan of Atmospheric Boundary Layer Observations Over Loess Plateau

Tetsuya Hiyama, Taro Shinoda, Atsushi Higuchi, Kazuhisa Tsuboki

HyARC,Nagoya University,Japan

The purpose of this research plan is re-evaluation of water cycle system in the Yellow River Basin by means of atmospheric boundary layer (ABL) measurements in "Loess Plateau", numerical climate models, and satellite remote sensing analyses. The improvements of parameterizations schemes in the processes of ABL, cloud physics, and precipitation systems will be also studied.

The ABL measurements are employed in the meteorological field of the "Changwu Agro-Ecological Experiment Station on Loess Plateau, Chinese Academy of Science".

The measurements include surface flux observations of momentum,sensible heat, latent heat ,and carbon dioxide. Also included are the profile measurements of 3-dimensional wind speed, air temperature, and absolute humidity in and around 30 minutes intervals. These will be measured by a Wind Profiler and a Microwave Water Vapor Radiometer. The obtained data sets will be used for the re-evaluation of parameters of ABL turbulence, entrainment process, and cloud physics in cloud-layers, using cloud resolving models (CRMs).New parameterization schemes will be added to regional climate models (RCMs) and re-evaluation of water cycles system in the Yellow River Basin will be achieved.

New devices will be prepared during fiscal years in 2003 and 2004.After transportation and establishments of the devices, continuous measurements will be done until fiscal year of 2006.Parameterizations using CRMs and applications of RCMs will be done until 2007.These new parameterizations are possible to apply for the re-evaluation of water cycle system in the Yellow River Basin.

Research Plan of Water Budget and Water Use in an Inland River Basin of Western CHINA

Jumpei Kubota

Research Institute for Humanity and Nature,Kyoto,Japan

This study focuses the changes in the hydrological cycle during the past fifty years cased by the water resource development in the Heihe River basin, an inland river of the arid region in the western China. The Heihe River basin consists of three parts, namely the upper mountainous area which is the source of the Heihe River by rather big amount of precipitation and glaciers, the middle oasis area like Zangye and Jiuquan, and the lower terminal arid area like Ejina. Each area has independent hydrological condition and ecosystem. Surface runoff from the upper mountain area by rain and melt water of snow and glaciers is the only source of water available in the middle oases area and the lower arid area. The increase of water demand in the middle oases area mainly by irrigation for agricultural land has resulted in the decrease of surface water supply for the lower arid area. The degradation of vegetations and the difficulties of the usage of shallow groundwater in terms of not only quantity, but quality have become serious problems. Even in the middle oasis area, over 80% of the total discharge has been diverted from main river courses to many irrigation canals, resulting in not only the rise of groundwater level inside the cultivated oases, but also the increase of soil salinization area. At the same time, the decrease of discharges in the main river courses have formed deserted area. Based on both field investigations of the hydrological processes, including stable isotopic analysis, and information of irrigation systems, a distributed hydrological model with the grid based will be developed to understand the spatial distributions of water budget in the Heihe River basin. The effects of the water resource development on the hydrological cycle in the Heihe River basin will be discussed by the model. The detailed research plan and some preliminary results will be presented.

Land and Water Management Issues in Large Irrigation Scheme
-Case Study of the Hetao Irrigation District in the Yellow River Basin-

Tsugihiro Watanabe

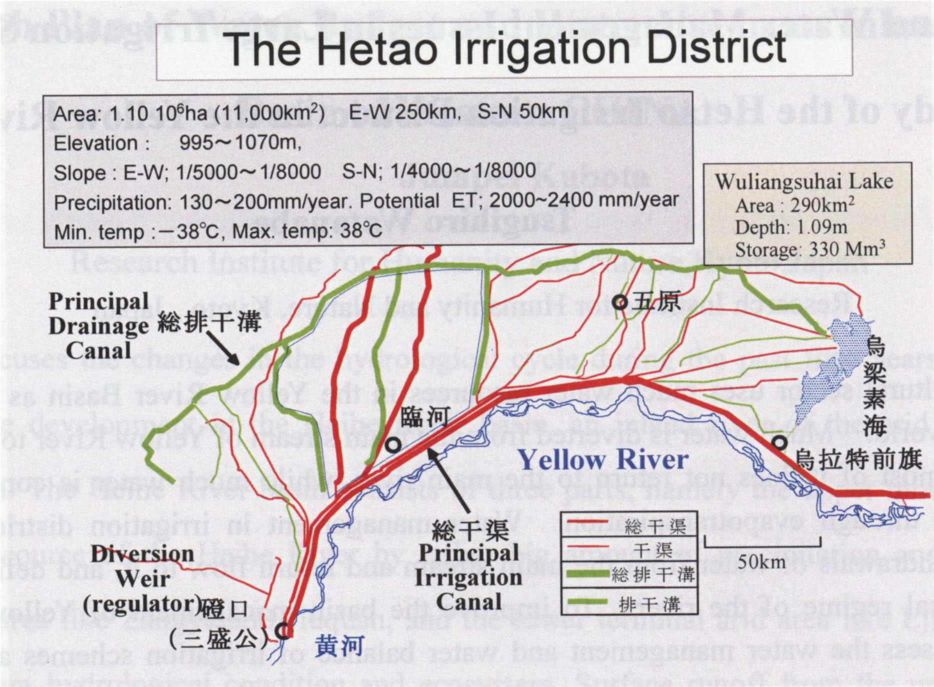
Research Institute for Humanity and Nature, Kyoto , Japan

Agricultural sector uses much water resources in the Yellow River Basin as well as other basins in the world. Much water is diverted from the main stream of Yellow River to the irrigation scheme, and most of it does not return to the main river, while much water is consumed in the irrigated field through evapotranspiration. Water management in irrigation district determines amount of withdrawals of water from the main stream and return flow to it, and definitely affects the hydrological regime of the river. To improve the basin management of Yellow River, it is essential to assess the water management and water balance of irrigation schemes as the biggest water users.

From agricultural points of view, assessment of water management in irrigation district is also required to enhance water use efficiency and to save irrigation cost, simultaneously with land and cropping management evaluation, which is inseparably connected with water management. Especially in arid areas, since irrigated land might suffer from soil salinity problem, appropriate soil and water management is crucial issue.

The case study area Heato Irrigation District is the largest Irrigation Scheme in the Yellow River Basin, which is located in the Inner Mongolian Autonomous Region. Its irrigated area has reached to about 600 thousand hector, and its annual diversion is about 5 billion m^3, which is considerably big amount. While water use in this region affects water use in the downstream regions, water balance of this district is not clear. On the other hand, there is soil salinization problem in this district. According to the continued field reclamation program, the salinazation problem is gradually being alleviated, with field measurement and analysis on soil and water movement from soil hydrological aspect. The most effective measure to control salinity problem is to leach out the accumulated salt with much water application to field. The salt balance of the whole district, however, is also not clear as well as water balance. In this district, to save water in the basin, the diversion amount is to be reduced from previous 5 billion m^3 to 3.8 billion m^3 per year. The question is how can the reduction be realized and what will happen in the future.

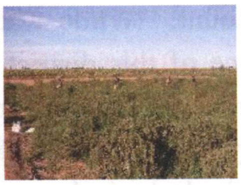
In this paper, identification of the problems and research framework are discussed, based on some diagnostic studies and review of the previous research results. This research plan is being implemented as a part of the RIHN Yellow River Research Project and the CREST Yellow River Research Project.



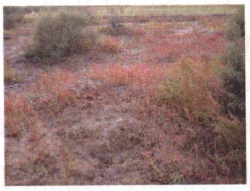
Farmland and Salinization


Maize and wheat


Fields with and without salinity problem


Field under reclamation with salt tolerant crop


Field suffering from salinity problem


Salinity problem in a field


Salt accumulation

Developing Plan of hydrological cycle and water use model in the Yellow River basin

Xieyao Ma[1], Yoshihiro Fukushima[2] and Tetsuzo Yasunari[1,3]

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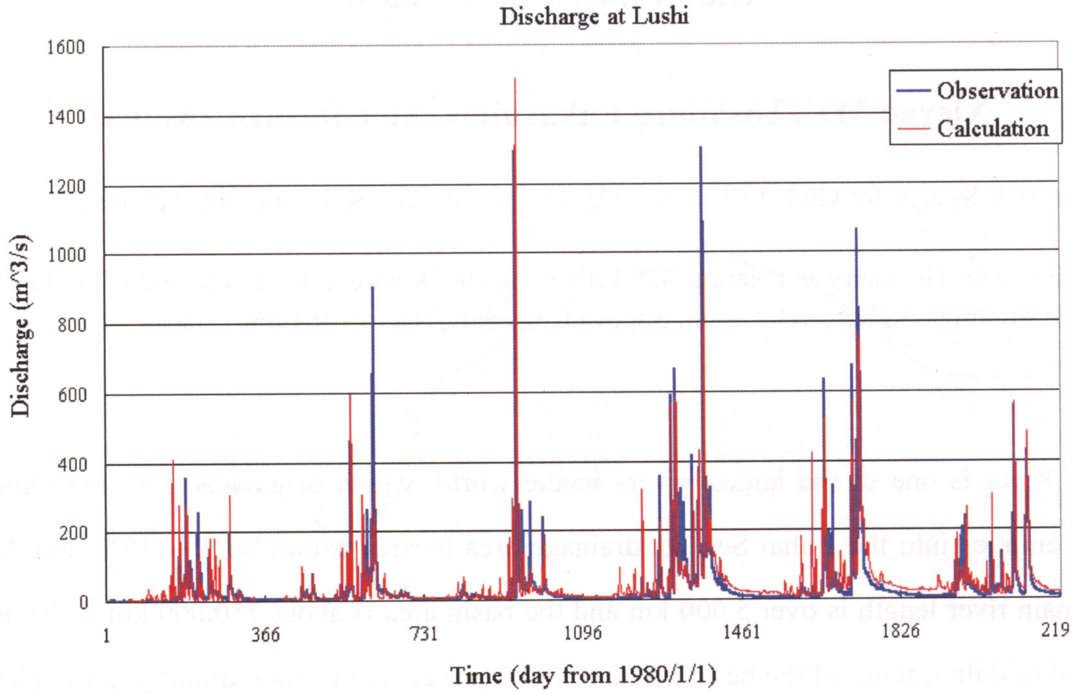
[2] Research Institute for Humanity and Nature, 335 Takashima-cho, Kamigyo-ku, Kyoto 602-0878, Japan
[3] Hydrospheric Atmospheric Research Center, Nagoya University, Nagoya 464-8601, Japan

The Yellow River is one of the largest rivers in the world, which originates from the Qingzang Plateau and empties into the Bohai Sea. Its drainage area locates within 96°E ~119°E and 32°N ~ 42°N. The main river length is over 5,000 km and the basin area is about 750,000 km^2. The area of the upper and middle reaches of the basin account for 95 per cent of its total drainage area. The west area belongs to the Qingzang Plateau, with an altitude of over 3,000 meters; most of the middle area belongs to the Loess Plateau, with an altitude of 1,000 to 2,000 meter and the east of the basin belongs to the Huanghuaihai Plain, and the river channel hangs over the ground of the river bank. The hydrological regime of the basin has been changed along with the climate, irrigation area and water demand change. In the past 27 years from 1972 to 1998, the event of zero-flow in the downstream occurred in 21years with a total duration of 1051 days.

In order to understand the hydrological cycle processes of the Yellow River basin and to determine the water budget for the whole basin, we will try to setup a model system. In the model system, main processes of water and energy transfer between atmosphere and land surface, water movement in land surface, and water use for irrigation will be considered in a 0.1°-degree size resolution. In the paper, some results of GAME-Siberia Project, FORSGC-IMH Mongolia Project and PILPS-2e Project will be shown as previous studies in hydrological model development. A preliminary result of existing model application to the Luohe river basin, a small tributary river in the downstream of the Yellow River will be introduced to examine the model performance.


Discharge at Lushi
Observation
Calculation
Discharge (m^3/s)
1600
1400
1200
1000
800
600
400
200
0
1
366
731
1096
1461
1826
2191
Time (day from 1980/1/1)

Numerical Study of Climatic Rainfall distribution over Tohoku and Hokuriku Region in Japan Area during Winter Monsoon Season

Takao Yoshikane(FRSGC) Fujio Kimura(FRSGC,Tsukuba Univ.), Kumiko Takata, Katsunori Tanaka,Xieyao Ma, Ken Motoya, Sung-Dea kang

It is expected to predict the water resource, especially snowfall, from the view point of the natural disasters and the agricultural water supply around Tohoku and Hokuriku region in Japan. Although some studies for the prediction of hydrological cycle process are conducted using regional climate models and hydrological models, there are few fruits because those studies just begun in a few years ago, and the numerical models still have a lot of problems. Many atmospheric climate model studies are conducted using more than 20km horizontal grid space, however, it is not enough to simulate the detailed precipitation including the snowfall exactly. Our group is planning to conduct the cloud resolved simulation during winter monsoon season using the Earth Simulator computer system, and investigate the possibility of prediction of water resource.

Features of both the large snow fall year from Dec.1983 to Mar.1984 and the small year from Dec.1989 to Mar.1990 are represented using a regional climate model every one month of each year in this study. The large and small year are defined by the calculated total volume of snow using the observation data and a hydrological model.

The large amount of precipitation appears in the coastal area of Japan Sea, Tohoku, Hokuriku, and Sanin region when the northwesterly wind has tendency to strong during winter monsoon season (e. g Jan.1990).This feature of precipitation distribution is reproduced by the model. On the contrary, the large amount of precipitation appears in the coastal area of Pacific Ocean side of Japan, and the precipitation in Tohoku, Hokuriku, and Sanin region becomes small when the northwesterly wind has tendency to weak during winter monsoon season (e.g.Feb.1990). Although the small amount of precipitation in the coastal are of Japan Sea is represented by the model, the precipitation in the Pacific Ocean side of Japan is not enough to be simulated. It is speculated that the calculation domain is too small to represent the precipitation distribution exactly. The difference of precipitation distribution between the large snow year and small year is qualitatively reproduced by the regional climate model in Tohoku, Hokuriku, and Sanin region during the winter monsoon season.

More study is needed to investigate the mechanism of the difference of precipitation between the large snow year and small snow year.

Economic Development and Water Resource Demand in Yellow River Basin: A Model Study on Crop Irrigation Water Requirement

Hidefumi Imura, Weihua Fang

Graduate School of Environmental Studies, Nagoya University,Japan

Yellow River Basin (YRB) has witnessed severe water resources shortage and caused extensive economic losses due to climate change and fast socio-economic development during the past several decades. The average water resources in YRB is around 580×10^8 m^3, of which around 300×10^8 m^3 was allocated to agriculture sector according to the past *10* years water allocation practice. Agriculture sector consumes the largest portion of the available water resources in YRB and crop irrigation water requirement is the most important part in agriculture water demands.

Climate Change has heavy impact on agriculture water demand in various aspects. Differing from industry and domestic sectors, agriculture water demand is heavily influenced by climate components, such as precipitation, radiation, temperature, humidity, wind, and consequently evapotranspiration. According to past the instrument weather records, the precipitation of most areas in YRB decreased from 0.1% to 0.6% annually. Instead, the temperature increased from 0.1% to 0.9%. Results General Circulation Models (GCMs) show similar climate changing trend in the coming 30 to 50 years in YRB.

The major objective of this study is to assess the impact of climate change on crop irrigation water requirement in YRB. The objective could be achieved by the following key sub-objectives: 1) Establishing climate change scenarios from GCM (HADCM3) output results, 2) Calibrating empirical models for calculating ET in YRB, and 3) Assessing impact of climate change on irrigation water requirement with crop water requirement models.

Detachment of Natural Loess Soil by Shallow Flow

Guanghui Zhang

CREST Researcher

Soil erosion is one of the most serious environmental issues in Yellow River basin and has closely relationship to sediment transport, river bad raise, flood control, and water resource management in the down stream of Yellow River. It is very significant to understand the basic processes of soil erosion and to develop prediction model to direct the action of soil and water conservation and to reduce soil erosion in this region.

Soil detachment, sediment transport, and deposition are three sub-processes of soil erosion. Quantification of soil detachment rates is necessary to establish a basic understanding of soil erosion processes and to develop fundamental-based erosion models. Many studies have been conducted on the detachment rates of disturbed soils, but very little has been done to quantify the rates of detachment for natural soil conditions. This study was conducted to evaluate the influence of flow discharge, slope gradient, flow velocity, shear stress, stream power, and unit stream power on detachment rates of natural, undisturbed, loess soil. Flow rates ranged from 0.25 to 2.0 l s^{-1} and slope gradient ranged from 8.8% to 46.6%. This study was compared with a previous study that used disturbed soil prepared by static compression. The results indicated that the detachment rates of disturbed soil were 1 to 23 times greater than the ones of natural undisturbed soil. It was necessary to use natural undisturbed soil samples to simulate the detachment process and to evaluate the influence of hydraulic parameter on detachment rate. Along with flow rate increasing, detachment rate increased as a linear function. Detachment rate also increased with slope gradient, but the functional relationship between the two variables depended on flow rate. Stepwise regression analysis indicated that detachment rate could be well predicted by a power function of flow rate and slope gradient (R^2=0.96). Mean flow velocity was closely correlated to detachment rate (r^2=0.91). Flow detachment rate was better correlated to a power function of stream power (r^2=0.95) than to functions of either shear stress or unit stream power.

Dynamics of Salt and Change in its Composition on Irrigated Lands and on Non- Irrigated Lands in Arid Region

–A Case Study on Hetao Irrigation District, Inner Mongolia, China-

Takeo Akae*, Toru Uno* , Haibin Shi, ** and Yanlin Li, ***

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** Inner Mongolia Agricultural University, ***Shahaoqu Experimental Station

In arid land agriculture, irrigation gives decisive influence on movement and chemical state of salt in the soil. Therefore it is important to understand the process in planning to avoid salt accumulation and to improve the salinized land by irrigation. The objectives of this study is to investigate the movement, reservation and change of salt in the soil in relation to water movement pathways from soil to the ground water and drainage canal water. For this purpose, field measurements and analysis in the laboratory were carried out. Total salt concentration and composition of salt in irrigated water, in soil solution and in ground water were measured at an irrigated land and a non-irrigated land as well as irrigation water and drained water, in Hetao Irrigation District, Inner Mongolia.

The major obtained results are as follows;

(1) At the intake from the Yellow River, the water quality was comparatively good (EC: 1 mS/cm, SAR 3-5), however, after passing the soil the quality of the ground water was deteriorated both in EC (3 - 7 mS/cm) and SAR(7-20). The water quality of the ground water was almost the same as that of the drainage canal water.

(2) While the EC of the ground water of the non-irrigated land was the almost same as the ground water of the irrigated land, SAR of the non-irrigated land was higher than that of the irrigated land.

(3) Na^+ ion was predominant in water-soluble cations, and the rate of Na^+ in all the cation was higher when the total salt concentration was high.

(4)By acetic-acid ammonium extraction, the rate of dissolved Ca increased dramatically. It means that there exists much calcium in the soil as water-insoluble salt.

(5)Both the ground water and the saturation extracts were in the status near the saturated dissolution of calcium carbonate.

Measurement of Soil Salinization using Electromagnetic Induction Technique

- A case study of the Hetao Irrigation District, Inner Mongolia, China -

Takashi Kume *, Takanori Nagano **,
Tsugihiro Watanabe, **Toru Mitsuno*
*Graduate school of agriculture, Kyoto University
**Research Institute for Humanity and Nature (RIHN)

To manage crop field soil salinity in arid zone, it is very important to assess the degree of soil salinization and to control the distribution of irrigation water. The electrical conductivity is one of the most useful salinity indices. ECa (apparent electrical conductivity) can be measured very quickly using electromagnetic induction technique (EM technique). Rhoades et al. (1976) stated that ECa has high correlation between soil salinity under constraint condition. The aim of this study was to analyze horizontal soil salinity distribution using EM technique and to analyze correlation between soil salinity and crop height. For this purpose, we set up two investigation sites (site A, B) and measurements were carried out. EC of the soil water extract (EC1:5) and ECa measured by EM technique were compared at site A. Meanwhile, ECa and crop (sunflower) height were measured at over 1600 points at site B, and ECa contour map and crop vegetation map were made and compared.

The main results were as follows;

(1) High correlation between apparent electrical conductivity (ECa) and soil salinity (EC1: 5) was obtained.

(2) ECa values measured by EM technique were highly correlated to crop (sunflower) growth.

Drain-off of the Yellow River and the comprehensive control of the Yellow River Watershed

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Institute of Soil and Water Conservation,
Chinese Academy of Sciences and Ministry of Water Resources

1. The Yellow River is a special river

1.1 Be famous for easily choked, breached and moved.

The Yellow River is a river with heavy flood in China. Since the Qin Dynasty, the river course from Hua Yuan Kou changed constantly; it flickered between Tian Jing city and Bing Hai County, Jiang Shu Province. Before the year of 1194, it flowed into Bo Hai and 1194-1855 into Huang Hai. After the year of 1855, it flowed into BoHai again. During the 2540 years from 602 B.C to 1938 A.D, it breached 1,590 times, changed its course 26 times extensively and changed its course special extensively 9 times. The frequent change of its course brought great suffering to the people living in two banks.

1.2 Frequent drought

Drought is frequent in the watershed of the Yellow River. During the 268 years of Qing Dynasty, drought happened 201 times. In 1929, heavy drought happened in thousands of miles, with 34,000,000 people suffering from drought. It sustained for 5 years and involved in several provinces, such as Shaan, Gan, Jing.In the heavy drought of 1995-1997, people and domestic animals in many places of Loess Plateau had no drinking water, thus the government had to transport water to maintain lives of local people.

The Yellow River valley is the most suitable place to live in history, which can be proved by the ancient metropolises, such as Chang'an, Luo Yang, and Kai Feng.The deterioration of eco-environment began in Qing and Han Dynasty, prevailed in middle-Tang and prevailed further in dynasty of Ming and Qin. Forest and grassland lost and the Loess Plateau was eroded greatly. Silt from the Yellow River inundated Yu Lin, Tong Wan and so on. At present, ratio of forest cover on Loess Plateau is less than 1/2 that of the whole country, less than 1% in the most serious place. The eco-environment is very fragile and hardly rehabilitated if it is deteriorated.

1.3 Water amount is decided by upper-middle reaches and silt is decided by middle reaches

Water from the area upper Lan Zhou accounts for 58%, silt accounts for 9%. From He Kou town to Tong Guan, the watershed covers 310,000 km^2, water from this area is 18,700,000,000 m^3, accounts for 33% of the runoff, while silt accounts for 90%, with 800,000,000 tons of sand deposited in lower reaches per year. Average silt content is 3 $kg/m^3 \cdot a$ in Lan Zhou course and 6 $kg/m^3 \cdot a$ in Bao Tou course. Silt content is increased greatly when the river flows through Loess Plateau, with 145 $kg/m^3 \cdot a$ in Yong Ding river and 30 kg/m^3 in confluence site. It is 161 kg/m^3 in the confluence of Luo He, Jing He and Wei He. It is 35 kg/m^3 when the river flows out Shaan'xi, with a maximum of 580 kg/m^3. It is 38 kg/m^3, with a maximum of 911 kg/m^3 in SanMenxia.

1.4 Naturally Deficient Water Resources

Total amount of water resources is 280,000,000 m^3 in China, and 80 percent of it distributes in the south area beyond ChangJiang River. The amount of water resources is only 2,400m^3 per person. Water resources in Yellow River watershed only account for 2.7%, and the amount per person is only 742 m^3, which is 1/4 of native level. Since 1970s, the rainfall decreased in the upper and middle of Yellow River, and in 1980s it decreased by 5% and in 1990s by 13%. Thus water from upper reaches and middle reaches decreased 1,600,000,000 m^3 and 6,700,000,000 m^3 respectively. Runoff decreased by 19% in 1990s. In 1995~1997 period, with drought in whole watershed serious drain-off was happened. But in 1927~1931 period, Block Channel was not happened with runoff decreased by 34%.

2 Drain-off of the Yellow River

Before 1960s, efficiency of water resource was low. Drain-off happened seven times during 1972~1980, with the average duration of 9 days per year. The average duration was 11 days in 1980s. Since 1991, Drain-off happened every year, and duration became longer and longer, with 122 days in 1995, 136 days in 1996, 226 days in 1997, and 133 days in 1998 which was a plentiful rainfall year. Extent of drain-off became more and more, with 742km in 1995. The date of drain-off became earlier and the most serious happened in February. The degree of drain-off was aggravated and it also happened in flood seasons. Drain-off happened 13 times in 1997.

2.1 Serious Pollution and Wasted

Water in Yellow River was used mostly in agricultural irrigation and efficiency was low. Recycled efficiency of industry water was only 30%. Polluted length of Yellow River account for 71% of the whole watershed. Recycled efficiency of polluted water was under 21%.

2.2 The water demand was exceed supplied

Efficiency of Yellow River runoff has coming to 65%, now the area irrigated with Yellow River water increased to 7,400,000 ha from 800,000 ha in 1949. The resource of Yellow River couldn't satisfy the increasing water demand.

2.3 Exploit underground water excessively

The ground has subsided in large area because of the excessive exploitation underground. For example, the subsidence areas in Xi'an city in Taiyuan city were 1,000 km^2 and 216 km^2, with the max depth 1.5m and 1.8m, respectively.

3 Measure for preventing drain-off of the Yellow River

3.1 Adding sources

3.1.1 Moving water from south china to north china is the basic measure to prevent the Yellow River from draining off. The project has east、middle and west subprojects. The east and middle subprojects can only resolve the problem of water resource between need and supply in the lower reaches, while the west one can improve the eco-environment in upper and middle reaches with a lower economic benefit. Comparing with the east and middle subprojects, the west has higher benefit in economic、ecology and society aspects considering of eco-environment construction and comprehensive use of soil and light-heat resource in upper reaches. Thus it should prepare for the west subproject from now on and put it into practice in the early 21 century.

3.1.2 Constructing base to increase rainfall artificially in upper reaches of Yellow River. It can increase the amount of headwaters, and also improve eco-environment.

3.1.3 Using seawater to wash out the deposited silts. Seawater should be used adequately, such as in industrial and agricultural production and living after being desalted or in washing out the deposited silts.

3.2 Storing runoff

3.2.1 Blocking and storing runoff water. Ancient people had created water collecting technology for fighting drought, gathering and using rainfall in the Yellow River watershed. Runoff from slope, village and road was stored in water cellar, storage pond to supply water for human and animals. Measures of fish-scale pits, terraced fields were adopted to block slope runoff , recover vegetation, control water loss and soil erosion.

3.2.2 Blocking flood.

The Yellow River watershed is deficient in water resource, however a lot of flood runs into sea every year. Building reservoir in plat can store water for deficient rainfall year.

3.2.3 Cleaning polluted water and reusing it in the whole watershed.

3.3 Administration

Fluxion varied among seasons of the Yellow River obviously, that means, maximum is 2.5 times as much as minimum. So, a reasonable plan should be made to manage the water in different seasons of different rainfall year.

4 The control of the Yellow River watershed

Improve the environment of the Yellow River watershed and resolve the serious flood and drought. The construction of environment should be strengthened in upper and lower reaches of the Yellow River watershed. It lies in administrating the gully; controlling water loss and soil erosion, lessening the dangerous caused by the deposit of silt in lower reaches. At the same time, usage of the 10,000,000,000m^3 water to shed silt can be changed into the production of industry and agriculture.

4.1 Administering upper reaches of the Yellow River

The key of administer the upper reaches of the Yellow River lies in improving eco-environment.. Natural protected zone should be found by migration strategy in the area where environment can't meets human's need. Also, artificial rainfall area could be constructed to recover vegetation.

4.2 The administration of Loess plateau area

The administration of Loess plateau area began in 1930's and some experiences have been accumulated. In 1986, a comprehensive demonstration zone was founded in Chang Wu county, Shaan'Xi province,PRC. A measures concerning road, water, field, fruits and forest were practiced, thus the field yield was increased from 2,700kg/ha to 3,750 kg/ha, and forest and grass cover ratio was increased from 18% to 45% and soil erosion rate was below 800t/(ha·a) in the 10 years continuously.

4.3 Administering lower reaches of the Yellow River

Riverbed should be deepened in order to dredged up the silts in lower reaches of the Yellow River. Seawater runs into riverbed, thus lead to riverbed being cut significantly. The ability of transporting the silts should be strengthened in narrow-deep riverbed, and wide-shallow riverbed be changed. Silts should be dredged up and washed into sea in flood periods.

GROUNDWATER INPUTS TO THE COASTAL ZONE

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Both terrestrial and marine forces drive underground fluid flows in the coastal zone. Hydraulic gradients on land result in groundwater seepage near shore and may contribute to flows further out on the shelf from confined aquifers. Marine processes such as tidal pumping and current-induced topographic flow may occur anywhere on the shelf where permeable sediments are present. The terrestrial and oceanic forces overlap spatially and thus measured fluid flow through coastal sediments may be a result of composite forcing. We thus define "submarine groundwater discharge" (SGD) as any flow out across the seabed, regardless of composition or driving force. This process is often characterized by low specific flow rates that make detection and quantification difficult. However, because such flows (both recharge and discharge) occur over large areas, the total flux is significant. "Groundwater" is thus an important source of biogeochemically important constituents to coastal waters. When derived from land, groundwater-seawater interactions represent a pathway for new material fluxes to the coastal zone and may result in diffuse pollution in areas where contaminated groundwaters occur.

One of the main objectives of the Yellow River Project is to quantify the exchange between the river and the Bo-Hai Sea. An important parameter in such an effort is to characterize the mixing between the estuary and the oceanic waters. This can be done by analysis of natural radium isotopes, especially ^{223}Ra and ^{224}Ra that have half-lives (3.66 d and 11.4 d, respectively) on the same time scale as mixing rates in many near-shore environments. This approach works because there are sources of the isotopes in the near-shore waters from the river and possibly from SGD and there should be almost none in the open sea away from these sources (**Fig. 1**).

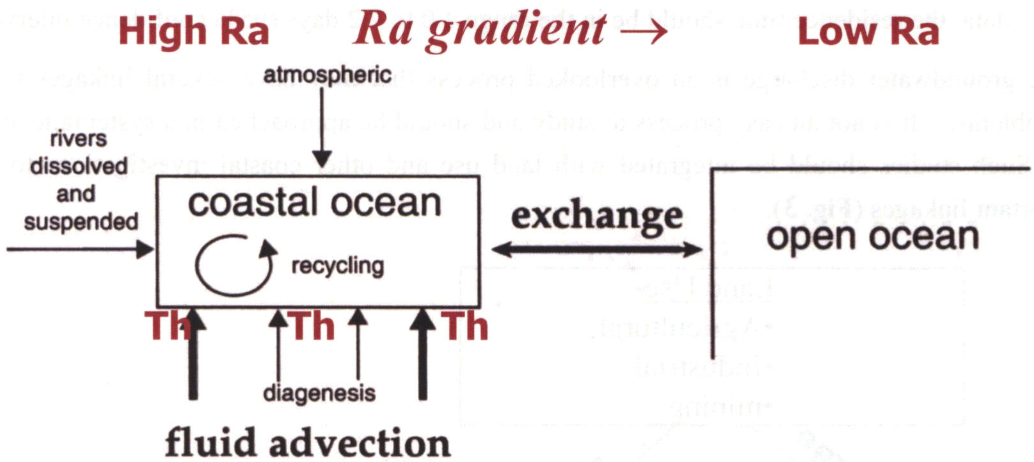

Figure 1. Diagrammatic view of how natural short-lived radium isotopes (daughters of thorium isotopes concentrated in the sediment) can be used to quantify mixing between coastal and offshore waters.

A residence time (average length of time the water remains in the system) may be calculated if the initial isotopic composition is known and assumed to be constant. In practice, the sampling usually consists of a transect or a series of transects extending from the river end-member (0 $^{o}/_{oo}$ salinity) out to sea to cover the entire salinity profile. Because of the highly seasonal discharge of the Yellow River, the length of such a transect will vary tremendously. Once the samples are collected and the measurements made, a residence time can be estimated from the following equation:

$$^{224}Ra_{obs} = {}^{223}Ra_{obs}\left(\frac{^{224}Ra}{^{223}Ra}\right)_i \bullet \frac{e^{-\lambda_{224}T}}{e^{-\lambda_{223}T}}$$

where T is the residence time in days, $(^{224}Ra/^{223}Ra)_i$ is the initial isotopic ratio, and $_{224}$ and $_{223}$ are the decay constants of the respective isotopes of radium. To illustrate this approach, a data set from a sampling off eastern Long Island (New York) is shown below (**Fig. 2**).

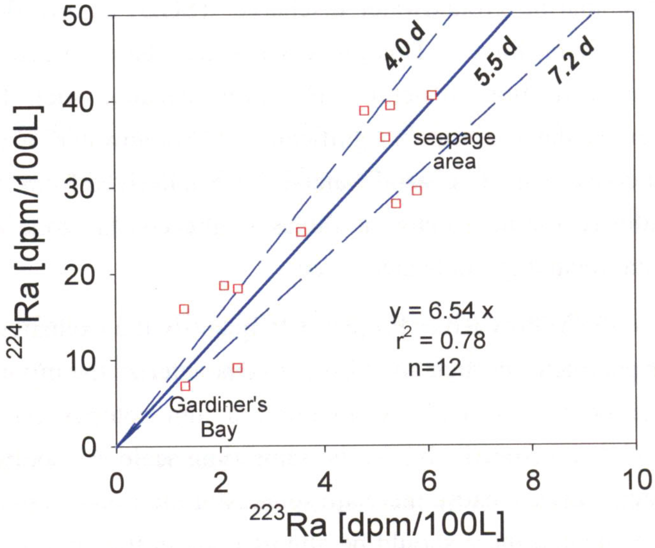

Figure 2. Activity of ^{224}Ra versus ^{223}Ra for 12 samples collected in a line away from an area of activity groundwater seepage near Shelter Island, eastern Long Island, NY. Based on the trend in the data, the residence time should be in the range 4.0 to 7.2 days (95% confidence interval).

Submarine groundwater discharge is an overlooked process that may have several linkages to real-world coastal problems. It is not an easy process to study and should be approached in a systematic, concentrated manner. Such studies should be integrated with land use and other coastal investigations to discern the most important linkages (**Fig. 3**).

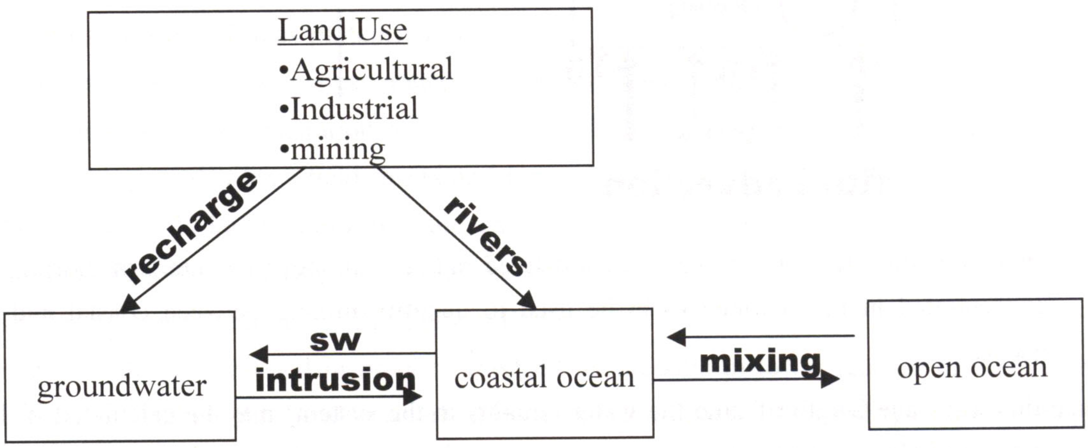

Figure 3. Linkages between land use, coastal aquifers, and the ocean. Effects measured in the

ocean may be consequence of activities in the interior with a groundwater pathway.

An IUGG Inter-Association Commission on "Groundwater-Seawater Interactions" combining scientific talents from the International Association of the Physical Sciences of the Ocean (IAPSO) and the International Association of Hydrological Sciences (IAHS) was formally organized in 2001 to help facilitate and coordinate research in this highly interdisciplinary subject. The joint commission plans to coordinate activities relating to this subject, organize workshops and symposia, participate in the planning and execution of various types of research, and actively engage scientists from developing countries.

Numerical analyses of groundwater seaward flux and estimation of delta seaward flux in Yellow River farm region

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Physiogeographic, geological and hydrogeologic conditions were Systematically investigated and analyzed in Yellow River farm region. Hydrogeologic tests and long-term observations were carried out. Hydrogeologic mathematical model was established at typical district of Yellow delta in Yellow River farm region. The changing trends of groundwater seaward flux and the influence degree of different factors were analyzed quantitatively. The study results show that the local meteorologic factors and water levels of Yellow River ,Small Island River and sea have different influence to the groundwater seaward flux, and the water level fluctuation of Yellow River and meteorologic conditions are the major factors influencing groundwater seaward flux in Yellow River Delta, and groundwater seaward flux is much less than surface runoff seaward flux.

A research plan on the interaction between river water, groundwater, and seawater in the Yellow River Delta

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The Yellow River does not reach often to the Bo-Hai Sea since 1970's because of huge amount of water uses for irrigation at midstream. Shortage of river water induces water pollution, decrease in groundwater level, and decrease of nutrient transports to the Bo-Hai Sea. The purposes of this study are; (1) to evaluate groundwater and river water discharges and their dissolved material transports into the Bo-Hai Sea, (2) to evaluate the effect of recent Yellow River cut-off due to changes in land utilization and water management on groundwater and Bo-Hai Sea, and then (3) to evaluate the interactions between Yellow River, groundwater, and Bo-Hai Sea in the delta (Fig.1).

Studies on land-ocean interaction in the Yellow River Delta are planed from 2003 to 2006 (Fig.2) though; (a) measurements of chemical components of water in the Yellow River, and (b) investigations of the groundwater and coastal water in the Yellow River Delta. River water will be collected at Ritsu for chemical analyses (DIN (NO_3, NO_2, NH_4), DIP, DON, DOP, TN, TP, Si, DO, pH, SPN) to evaluate the transports of dissolved materials to the Bo-Hai Sea through Yellow River. Interactions between groundwater and seawater in the Yellow River Delta will be evaluated using fiber thermo-radars (Fig.3), 10 automated seepage meters (Fig.4), CTD in 10 boreholes, and resistivity cables (Fig.5). Chemical analyses of submarine groundwater seepaged into Bo-Hai Sea will be made for isotope components (O-18, Deutrium, C-14, N-15), and dissolved components. Feasibility study on groundwater and Yellow River had been made on August 2002.

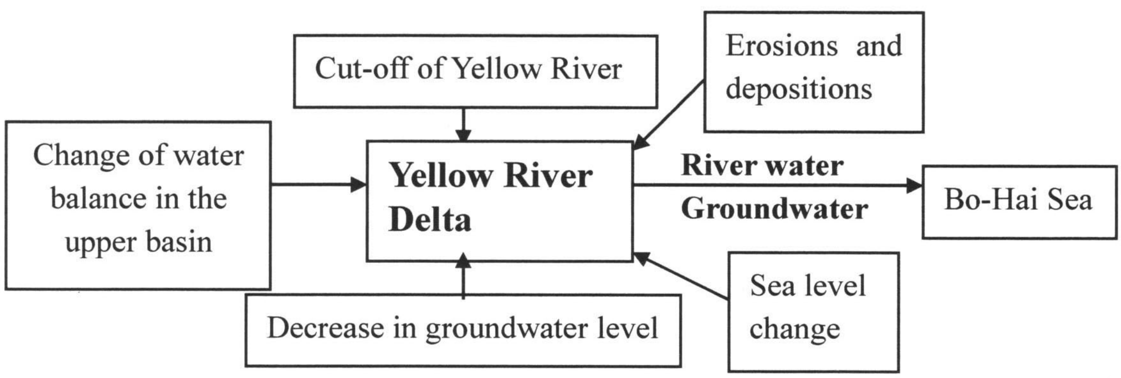


Fig.1 A framework of the study in the Yellow River Delta

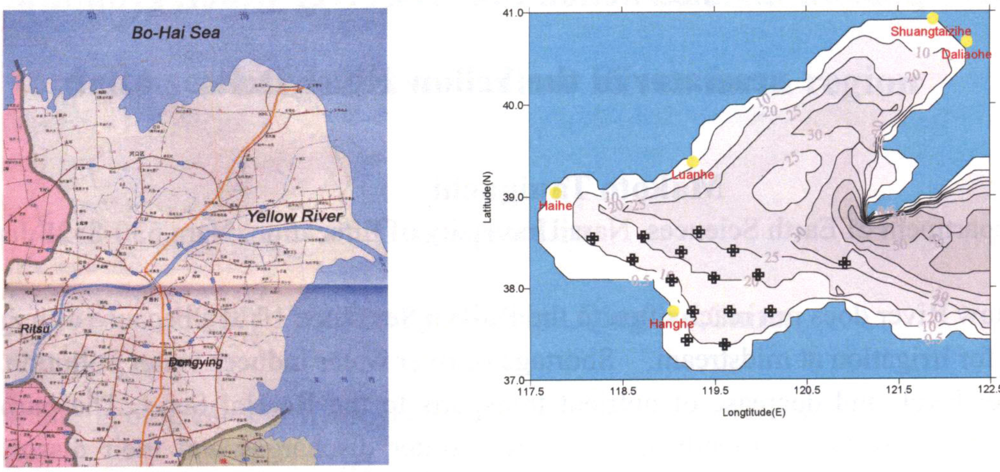


Fig.2 Land-Ocean Interaction in the Yellow River Delta and Bo-Hai Sea (submitted as a LOICZ Core Project)

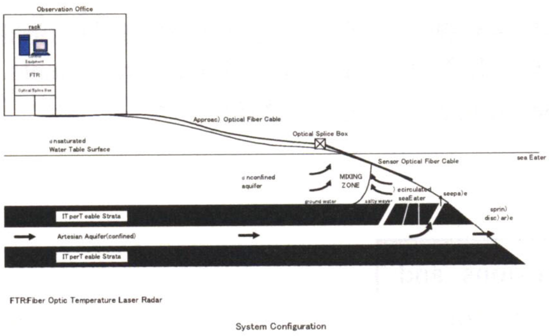


Fig. 3 Measurements of seabed temperature by Fiber Thermo Radars

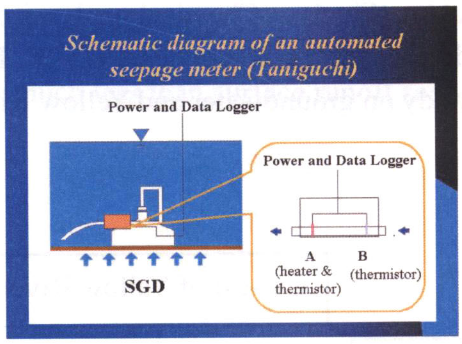
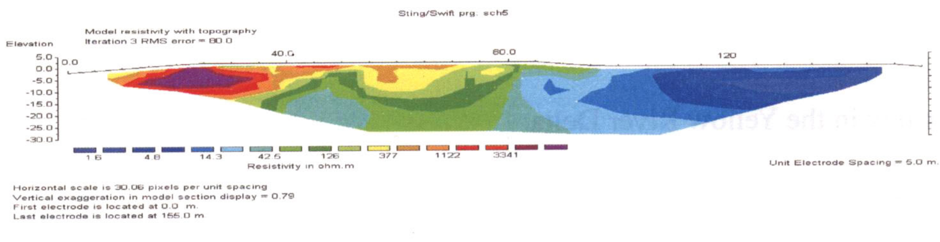


Fig. 4 Automated seepage meter



Modelling Studies on Marine Ecosystem in Bohai Sea

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The Bohai Sea is a typical shallow sea in which the average depth of water is about 18 meters, and which has a rich biodiversity and abundance of marine life. The values of primary production differ among four different regions of the Bohai Sea. Two models are used to study the dynamics of nutrients and primary production for the periods for 13 months from May 1982 to May 1983.

A biological model(NPZD) consisting of nutrients, phytoplankton, zooplankton and detritus is used to simulate the annual cycles of plankton and primary production in the different regions of the Bohai Sea. The simulation is forced by monthly observation data. Water transparency, nutrient concentrations, temperature and incident irradiance influence the amount and variation of plankton and primary production. The model simulations indicate that transparency and nutrient concentration are the principal causes of the differences in primary production in the different regions of the Bohai Sea.

A three-dimensional ecosystem model based on the cycles of phosphate and nitrate is developed for the Bohai Sea, which is coupled with a three-dimensional physical transport model. The model is then used to simulate the variation and distribution of chlorophyll-a, primary production and nutrient in 1982 and the simulation is validated by the data in 1982/1983. The concentration of both DIN and phosphate decreases from spring to summer and increases from autumn to winter in all the areas. The variation is a response to the consumption of the phytoplankton. In spring, the phytoplankton biomass increases as the temperature increasing and reaches the highest peak in summer. The concentration of nutrient drops to the lowest level during the same period. After the phytoplankton bloom of summer the dissolved inorganic nutrients increase gradually as the input of river increase and the decay of the thermocline.The variations of the primary production are same in different regions of the Bohai Sea. The high value of primary production appears in July and August and the lowest value appears in December and January.

Key words: modelling, primary production, nutrients, Bohai Sea

Bohai Sea Study Project

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Variability of the river discharge from the Yellow River is verylarge, thai is, between 5,000 m3/sec in early 1960 and 0 m3/sec in late1990, but the effect of such large variability to the marine environmentin the Bohai Sea has not been clarified yet.

The objective of this project is to clarify the effect of variabilityof Yellow River discharge to the marine environment such as watertemperature, salinity, current and lower trophic level ecosystem in theBohai Sea.

The participants of this project are T.Yanagi (Kyushu Univ.), X.Guo (Ehime Univ.) and M.Hayashi (Kobe Univ.) from Japan and Prof.Gao andother staffs of the Ocean University of China from China.

The methodology is 1) to conduct intensive field observations twotimes in the Bohai Sea, 2) to build up a numerical hydrodynamical modelof the Bohai Sea, 3)to build up a numerical ecosystem model of the Bohai Sea, 4)to gather visible and infrared satellite images during 1 year inthe Bohai Sea, and 5)to synthesize the results of 1)- 4). The expectedresults are the difference of marine environment such as temperature, salinity, current and lower trophic level ecosystem in the Bohai Sea between high river discharge and low river discharge from the Yellow River will be clarified by this research.

In the fiscal year 2003, we will build up numerical hydrodynamical and ecosystem models of the Bohai Sea and to gather visible and infrared satellite images of the Bohai Sea. In the fiscal year 2004 and 2005, we will conduct intensive field observation in September 2004 in the Bohai Sea. In the fiscal year 2006, we will reproduce the results of field observations by the numerical hydrodynamical and ecosystem models and to compare the results of field observations with satellite images. In the fiscal year 2007, we will synthesize the results.

Study on nutrients of Yellow River and the transport flux through Lijin hydrological station

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In recent years, great changes has happened in the ecosystem of Bohai Sea. Especially, the N/P ratio in Bohai Sea has increased dramatically. This study is designed to understand the change of nutrients in Yellow River and the transport to Bohai Sea through Lijin hydrological station which is 20 Km far from the estuary.

Three major aspects are addressed: ①concentration, fluxes and size fraction of all kinds of nutrients in the Lijin hydrological station in Yellow River and nutrients concentration and fluxes in groundwater in Yellow River Delta in 2001 and 2002; The nutrients flux in Yellow River and in Yellow River delta groundwater has been evaluated respectively. The nutrient fluxes in groundwater of Yellow River Delta is very little compared with that in the Lijin hydrological station in Yellow River into the sea, and its influence to the Bohai Sea ecosystem could be negligible. ②The amounts of nitrogen and phosphorus have been evaluated which were put into Yellow River from four resources (precipitation, fertilizer loss, soil erosion and sewage) from 1981 to 1998. It has been found that sewage is the key resource which dominates the amounts of dissolved nitrogen and dissolved phosphorus put into Yellow River. A primary model of nutrients put into large river has been established. ③Several factors which influenced the nutrients struction (ratio) in Bohai is found. Systematically analysis the series data of nutrients and biological parameters in the central Bohai Sea of 3 years and 10 cruises in recent 20 years, describes its changing tendency and primarily discusses correlations of each parameter. Also the relationship between changes in Yellow River drainage basin and nutrients in Bohai Sea has been discussed.

Therefore, it is quite important and essential for the research and protecting the ecosystem in the Bohai Sea.

Keywords: Nutrients; Drainage Basin; Yellow River; Bohai Sea

al Effect on Subsurface Flow and Biogeochemical Processes at the Coastal Area: some reviews and an research plan in the Yellow River Delta

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Some previous researches reported that direct discharge or nutrient load of groundwater into a marine is significant for the pathway of water and nutrient flow from the land to sea. However, it is difficult to estimate nutrient or contaminant load as well as groundwater discharge. Because both of nutrient and contaminant react chemically in the mixing zone between seawater and groundwater, it is necessary to estimate reaction process and its rate there. The mixing zone is formed not only by groundwater flow into sea with diffusion in a steady state, but also by tidal fluctuation. Based on the simulated results by some previous researches, the seawater intrusion into groundwater was controlled by tidal magnitude, groundwater gradient, and beach slope. It was strong under the condition of the large tidal fluctuation, small gradient and gentle slope. This means large mixing or dispersion of seawater in groundwater. In the coastal area of the Yellow River catchment, the river water did not reach to the Bo-Hai Sea before several years. Therefore, the groundwater gradient would be very small around the delta. In addition, beach slope is also very gentle. These situations would cause the large intrusion of seawater into groundwater in coastal and estuarine area. The objectives of this research are to confirm the intrusion of the present seawater into groundwater in a coastal and estuarine area, and clarify the biogeochemical process in mixing zone between groundwater, river water and seawater. In this research, we will install piezometers and pipes for water collection at several sites on three or four observation lines with collections of sediment samples, and collect water samples at the interval of two hours. In addition, we will conduct chemical analysis (anion, cation including trace metals and DOC, DN) and isotopic analysis (hydrogen, carbon, nitrogen, and oxygen) of water samples, and chemical analysis of sediment samples.

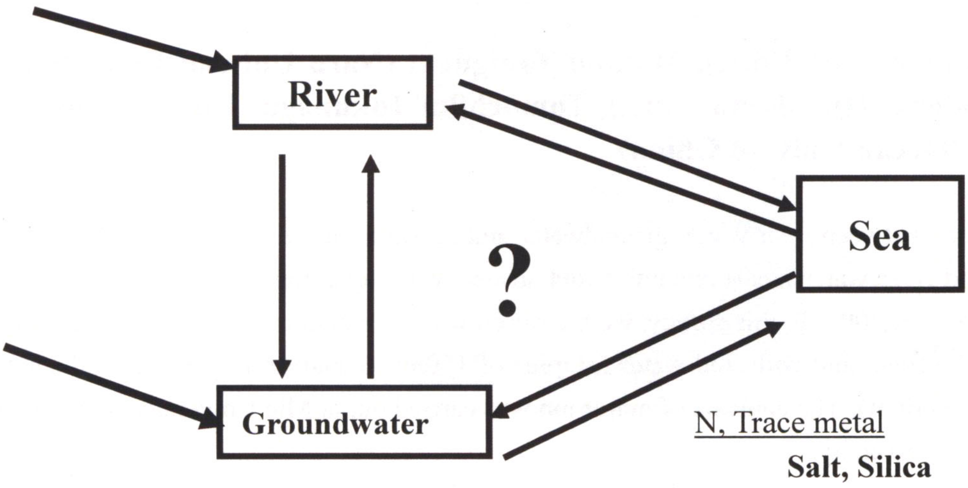

Fig.1　Unknown present element flux around the delta area

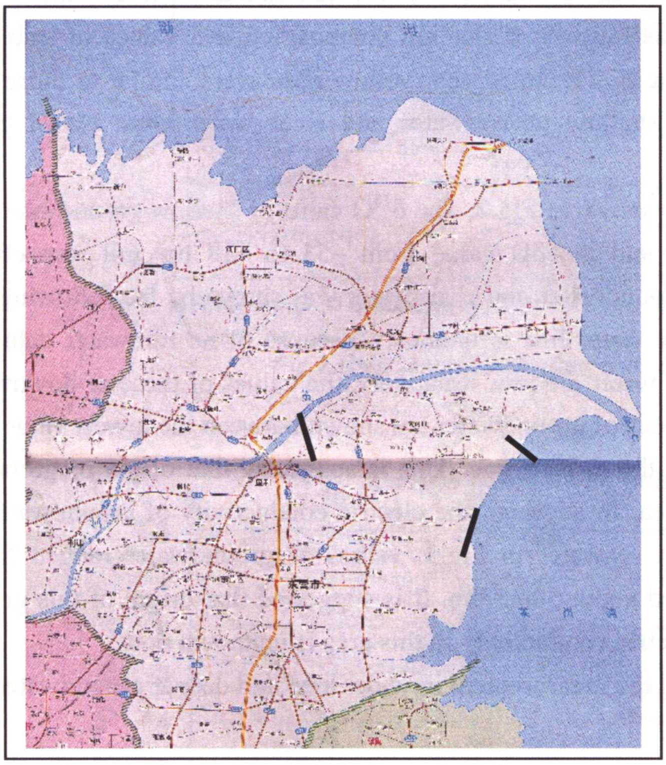

Fig.2　Observation lines on the study area

Water quality of shallow groundwater in the Yellow River Delta

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To clear that the interaction between river water, groundwater and seawater in the Yellow River Delta, we carried out groundwater and river water measurements about several water qualities and physical data as a general survey on August 9 – 11, 2002. In this survey, we measured water temperature, electric conductivity, pH, groundwater level in the field, and collected water samples of 150ml to analyze major ions and stable isotopes (oxygen-18 and deuterium). The analysis of major ion was carried out at Mie University, and that of stable isotopes was at Kyoto University.

The study area and measurement points were shown in Fig. 1. The study area is at the river mouth of Yellow River. The landform of this area is very flat, and formed delta. Geology is sand and silt, that is constructed by Yellow River flow. The speed of sediment is very quick, and the land area is expanding rapidly to the sea.

Yellow River is formed the raised bed river in this area, so it is considered that the river water recharges to the shallow groundwater. This is proved as follows: Major ion composition and values of stable isotopes ($\delta^{18}O$ and δD) of shallow groundwater that is distributed near yellow river were similar to those of yellow river water. Major ion compositions of shallow groundwater and river water were Na-Cl type at all measurement points.

The relationship between $\delta^{18}O$ and δD is shown in Fig.2. The $\delta^{18}O$ value of shallow groundwater and river water ranged from –7.2 to –2.2 per mil and the δD value from –53 to –18 per mil respectively. The regression line yielded from the data of groundwater and river water was shown by the following equation: $\delta D = 7.14\ \delta^{18}O - 1.78$. The Local meteoric water line is unknown because of no rainwater data now. The values of $\delta^{18}O$ and δD of the upward river water are low. Relatively, the values of these of downward (river mouth) river water are high. Almost all values of groundwater are shown between the lowest value of Yellow River water and the value of seawater on the mixing line. This is suggested that origin of groundwater is yellow river water and seawater in this area. In addition, the electric conductivity of groundwater near the coastline was higher than that of present seawater in Fig.3: values of groundwater ranged from 63 to 88mS/cm, value of present seawater ranged about 50mS/cm. It is suggested that origin of this groundwater isn't present seawater. A source of high electric conductivity in this area is unknown now.

In the future, it is necessary to carry out the measurement in wider area and deeper groundwater.

Fig.1

Distribution of measurement points

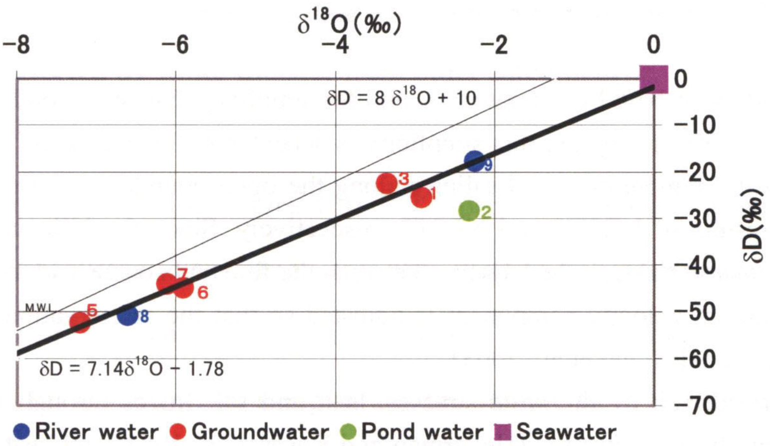

Fig.2 Relationship between $\delta^{18}O$ and δD

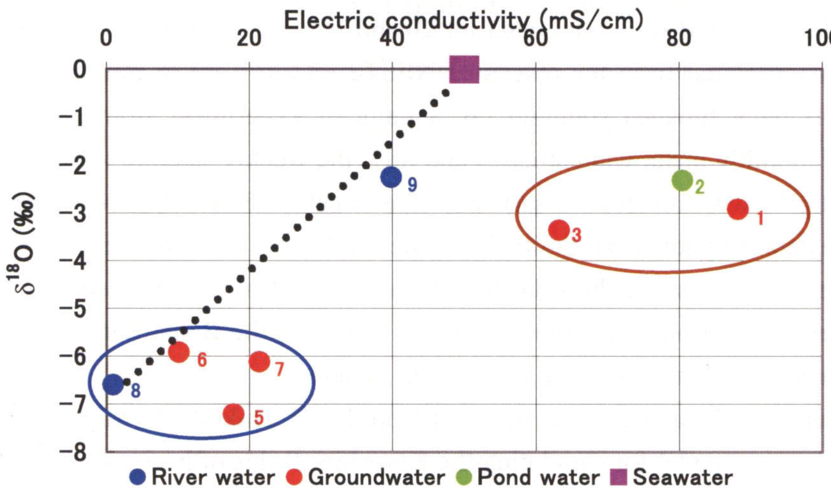

Fig.3 Relationship between $\delta^{18}O$ and electric conductivity

Seasonal variation of current in Bohai Sea simulated by a 1/18-degree resolution ocean model

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Based on Princeton Ocean Model (POM), we developed a triple-nested system for the Kuroshio simulation (Guo et al., 2003). The three models nested in this system are called NEST1, NEST2 and NEST3 in order of increasing horizontal resolution. NEST1, the coarsest grid, has a 1/2-degree resolution and covers almost the whole Pacific Ocean (40° S-70° N, 100° E-70° W). The NEST3, the finest grid, has a 1/18-degree resolution and covers the eastern Asian marginal seas (24°N-44°N, 118°E-150°E). Located between them, NEST2 has a 1/6-degree resolution and covers the northeast Pacific Ocean (0-63°N, 115°E-175°E).

The lateral boundary of NEST1 is treated as land for simplicity. Since its southern boundary is located at 40° S far from the Kuroshio region, this simplicity is acceptable. For the NEST2 and NEST3, the water elevation, velocity, water temperature and salinity along the open boundary are firstly guessed by bilinear interpolation of the results of NEST1 and NEST2, respectively. Since the bilinear interpolation does not conserve a volume transport through the interface between the fine and coarse grid model, the first guess of a vertically averaged normal velocity component is adjusted so that the conservation of volume transport is satisfied between two models (Guo et al., 2003).

These models are driven by the wind stresses, heat and salt fluxes through the sea surface. At the spin-up state, the monthly wind stresses (Hellerman and Rosenstein, 1983) and heat fluxes (Da Silva et al., 1994) are used while the salinity fluxes are set to zero. The monthly sea surface temperature and salinity in WOA94 (Levitus et al., 1994) are used in the correction terms of Haney type (Barnier, 1998).

The NEST1 and NEST2 started from a rest state with the annual mean temperature and salinity as in WOA94 (Levitus et al., 1994) and were integrated for 20 and 15 years, respectively. The NEST3 starts from the initial conditions interpolated from the results of NEST2 and its spin-up time is shortened to 3 years. After the three models have finished spinning up, a hindcast experiment from 1991.9 to 2000.12 was conducted. In place of monthly mean wind stresses and SST, the weekly satellite winds from the ERS-1 and ERS-2 (CERSAT, http://www.ifremer.fr/cersat) and the weekly SST blended from ship, buoy and bias-corrected satellite data (Reynolds and Smith 1994) are used in the hindcast experiment.

As a new feature of this system, the tidal forcing is included in the last two years of integration of NEST3. We will present the seasonal variation of current system in the Bohai Sea simulated by the NEST3 and also show the influence of tidal forcing on this current system.

All references listed here may be addressed in paper of Guo, X., H. Hukuda, Y. Miyazawa, and T. Yamagata (2003): A triply nested ocean model for simulating the Kuroshio -Roles of horizontal resolution on JEBAR-. Journal of Physical Oceanography, Vol.33, No.1, 146-169.

The impacts of diversion from the Yellow River on the local aquifer -case study in Shandong Province, China

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In order to solve salinazation problem in regions of downstream of the Yellow River, the diverted water from the river, used mainly for irrigation and leaching out the salt of the unsaturated zone to the aquifer, has great impacts on the local hydrological processes and aquifer system such as in providing extra water and exterior material, and accelerating the solvent transfer. Yucheng and Qihe cities, which are located in the middle part of Shandong Province, were chosen to study hydrological changes effected by water transfer from other catchments.

The diversion from the Yellow River, started in 1972, provides annually around 50-60% of total amount of local water resources to the study area that used to be waterlogged and is regarded as discharge zone in terms of hydrogeological conditions. The chemical pattern and the relationship of ^{18}O and deuterium (D) for ground water samples and the sample from the Yellow River tend to be unique for the study area, which differ from the area without the diverted water about 100 km to the north of Yucheng and Qihe cities. The whole aquifer system seems to be separated into two layers of shallow (less than 20 m) and deep (more than 20 m), and two strips of within and without 40 km from the Yellow River due to the long period of diversion. However, stream flow became less and less in the past two decades. Salinazation will occur again if no enough water from Yellow River to maintain this human-made agricultural region.

Nitrate pollution in groundwater in the lower reach of the Yellow River,- case study in Shandong Province, China-

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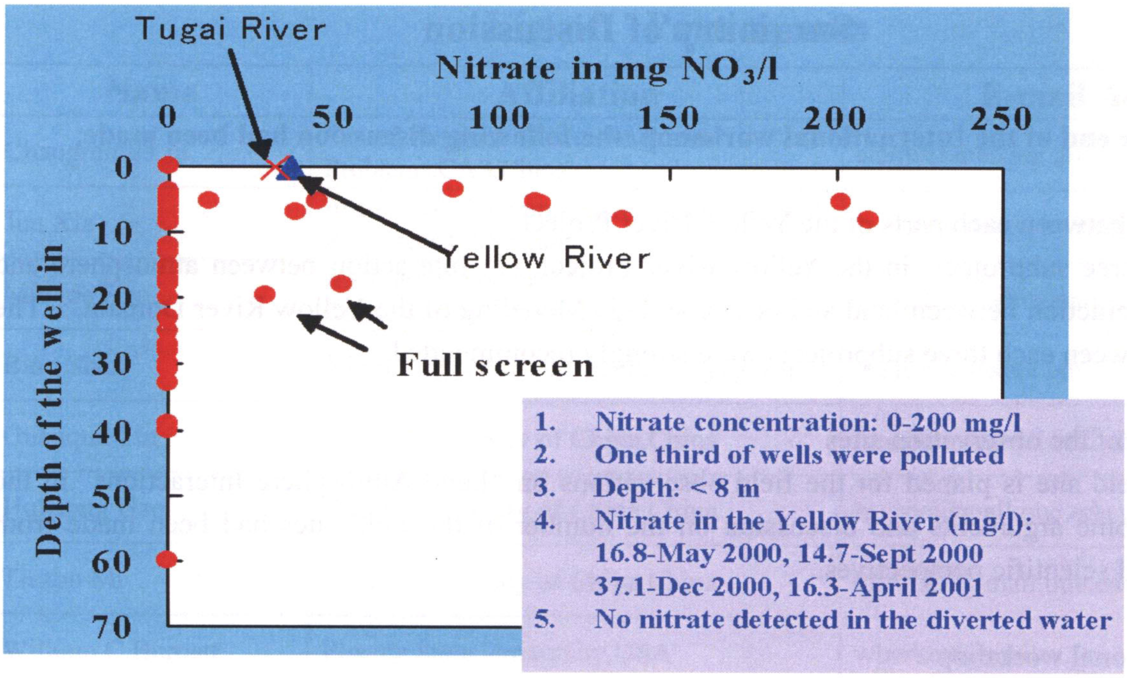
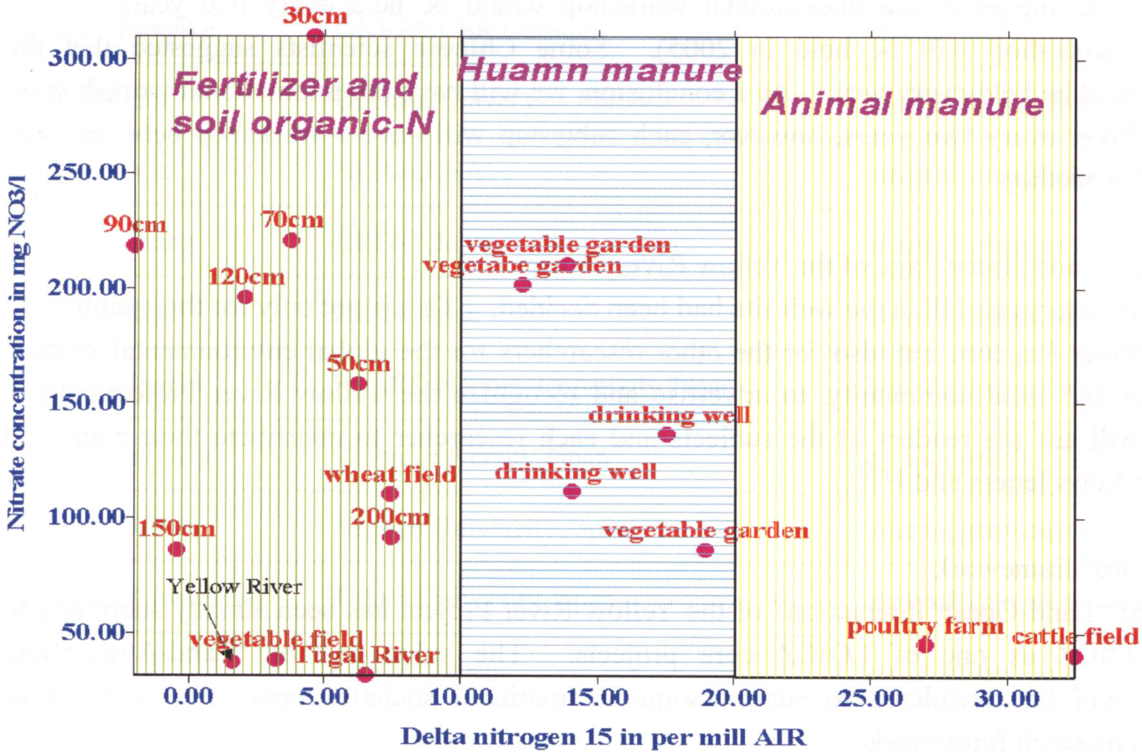
Yucheng and Qihe counties in the lower reaches of the Yellow River tended to be an important agricultural area after the Yellow River water was diverted in 1972. Field surveys and sampling were implemented in the area to examine the nitrate pollution of groundwater, which is recharged dominantly by the diverted water. Nitrate pollution was found to have occurred in the shallow layer of less than 8 m in depth with the highest concentration of more than 200 mg/l. Though nitrate content was found in the Yellow River ranging from 16.3 to 37.1 mg NO_3/l, it was not found in the canal, ditch and pond used to convey and store the diverted water, excluding the N source from the Yellow River. ^{15}N was measured to identify the nitrogen of anthropogenic and fertilizer/soil organic sources. The upward potential gradient of the saturated zone observed in the piezometers at Yucheng Experimental Station, the occurrence of ZFP at 120 cm depth, and denitrification process deduced from the change in $\delta^{15}N$ and SO_4 concentration helped explain why NO_3 was found only in the shallow layer of the aquifer.





Why does nitrate occur only in the shallow surface layer of less than 8 m depth: upward gradient potential in the unsaturated zone; frequent occurrence of ZFP at 120 cm depth in the unsaturated zone; denitrification processes.

Summary of Discussion

At the end of the International workshop, the following discussion had been made;

(1) Linkage between each parts of the Yellow River Project
There are three subprojects in the Yellow River Project; (1) Interaction between atmosphere and land, (2) Interaction between land and ocean, and (3) Modeling of the Yellow River Domain. The linkages between each three subprojects were strongly recommended.

(2) Number of the observation sites
Only one field site is planed for the field observations on "Land-Atmosphere Interactions" in the Plateau. Some arguments and discussion on the number of the field sites had been made from financial and scientific perspectives.

(3) International workshop
Prof. Fukushima suggested the international workshop would be held every two years. (Next international workshop will be held in 2005). Some Chinese scientists suggested that the workshop would be held every year. As a conclusion, we will have the international workshop on the Yellow River every two years, however, each subgroup will have a workshop between each international workshop.

(4) News letters and Home Page of the Yellow River Project
Making News letters and HP in the web site had been decided. This is not only for the members of the Yellow River Projects, but also for the other researchers for the global environmental studies, stake holders and local community, to advertise and recognize the Yellow River Project. Prof. Fukushima will ask the readers of the subjects and each researcher to contribute their plans and works to the News letters and HP.

(5) International framework
Subproject of "Land-Ocean Interaction" of the Yellow River Project has been already submitted to the IGBP/LOICZ as one of LOICZ core projects. The subproject of "Land-Atmosphere Interaction" will be considered to submit some international societies under the umbrella of international research framework.

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International Workshop on the Yellow River Studies

-Kick-off meeting- Program

*1) For oral presentation:

20 minutes for oral presentation and 10 minutes for discussion

OHP and PC projector are prepared at a meeting place

*2)For poster presentation:

Poster size (90cm in length and 120cm in width)

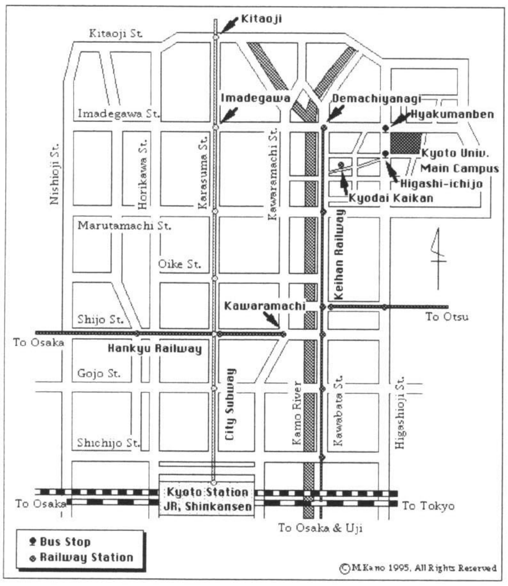
Setting; possible at 12:00 on 28th, Removal; after 14:00 on 29th

Each participant is requested to present the summary orally at Session 3 by three minuets

Place: Kyodai Kaikan(Tel. 075-751-8311)

Room #212 for oral presentation and Room # 211 for poster

Please see the following map



By City Bus from the Kyoto station (about 30 minuets)

Take a No.206 bus bound "Kitaoji Bus terminal", and get down at Kyodai-Seimonmae

By City Bus from the Sanjyo-Kawaramachi station (about 20 minuets)

Take a No.205 bus bound "Kitaoji Bus terminal", and get down at Koujin-bashi

Bus fee is 220 yen

Published

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