Final Activity Report for APN Project

- **Project Title:** Joint Support for Symposium on Adaptation of Asia and Pacific to Global Change in the 20th Pacific Science Congress

- **Reference No:** APN 2002-11

- **Abstract**

With the joint support from APN and some other funding sources, the symposium 2.1 on Adaptation of Asia and Pacific to Global Change in the 20th Pacific Science Congress was hold in March 17-22 Bangkok, Thailand. As one of the largest symposium in this 20th Pacific Science Congress, about 40 scientists from China, Fiji, India, Indonesia, Japan, Russia, Sweden, Sri Lanka, Thailand and USA took part in this events. The symposium aimed to discuss the adaptation of APN region to Global Change as to raise prepositional projects of further study. Divided into 3 sessions as follow " regional aspects of global change in Asia Pacific region, Impact Assessment of Global Change on Socio-economic Development and Strategic Adaptation to Global Change", this symposium received 39 oral presentations and 5 post presentations. A proceeding for this symposium 2.1 will be published in due course.

- **Project Information**

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List of collaborating countries: China, Fiji, India, Indonesia, Japan, Russia, Sweden, Sri Lanka, Thailand and USA

- **Introduction**

With more than half of the world's population, Asia and Pacific will have to seek innovative ways to promote sustainable and environmentally sound economic and social development in the region countries.

In recent years, Asia and Pacific region has made rapid progress in the field of Global Change. Under the support of Asia-Pacific Network for Global Change Research (APN) and START, we, as part of Asia-Pacific region, have also made a great progress in global change research. Scientists in this region should be given a chance to exchange their recent research results and discuss the common interesting topics related to global change, especially those linked with the regional development. One of the important issues will be how our Asia-Pacific region adapts to the changing world. With the research of impacts assessment related to IPCC and MA, the problem of adaptability has placed on the agenda. Scientists need to exchange their information to develop new research agenda and methods in the further study.

The 20th Pacific Science Congress, actually, provides a forum for us for the information changing. The 20th Pacific Science Congress with the theme "Science and Technology for Healthy Environments" is organized on the three major challenges: natural resources, social impacts and science and technology. Prominent scientists and scholars from all parts of the world have been invited to share their knowledge and experiences with participants from 50 courtiers. The congress consists of keynotes, symposia, poster presentation and exhibition. There are twenty-two symposia with 300 papers including 58 posters.

With the joint support from APN and some other funding sources from China, the symposium 2.1 on Adaptation of Asia and Pacific to Global Change in the 20th Pacific Science Congress is hold in March 17-22 Bangkok, Thailand. This project aims to discuss the adaptation of APN region to Global Change as to raise prepositional projects of further study.

- To exchange research result of regional adaptation and influence evaluation to global change;
- To discuss the process and countermeasure of adaptation;
- To raise prepositional projects of further study in APN region.

- **Activities Conducted**

- Preliminary Preparation

The preliminary preparation work of the meeting was carried out by the symposium secretariat since the project was approved by APN, which mainly includes the follow aspects: spread the announcement of calling for paper, make the decision of main topics of the symposium and choose keynote speakers, chair of the symposium, etc.

- Meeting Arrangement

  After the abstract submissions, the symposium secretariat cooperated with Thailand local host to arrange symposium 2.1: Adaptation of Asia and Pacific to Global Change. The symposium receives about 40 abstracts (see appendix III) from Asia and Pacific counties and participants mainly from the developing countries are to be financially supported. The draft program of this symposium (see appendix II) was arranged with following three major topics:

  a. Regional aspects of global change in Asia-Pacific region;
  b. Impact assessment on global change on the social-economic development
  c. Strategic adaptation to the Global Change.

- Meeting

  The symposium was held on March 17-18, 2003, in Sofitel Central Plaza, Bangkok, Thailand, with 2 days presentation (including poster session). The presentations are divided into three sub-sessions.

  As one of the largest symposiums in the 20th Pacific Science Congress, we have received 38 paper presentations from 10 couriers in the Asia-Pacific region during the preparation stage and about 70% of them are finally chosen to been presented in the symposium.

  After the opening ceremony of the Congress, the symposium 2.1 started with a welcome speech of Prof. Congbin Fu, vice-president of the Pacific Science Association and co-chair of symposium 2.1. Prof. Shu Sun, project leader of this APN Project 2002-11 and chair of this symposium 2.1, gave a brief introduction of this symposium.

  The session one “Regional Aspects of Global Change in Asia Pacific Region” chaired by Prof. Kasaem Chunkao, co-chair from Thailand, and Prof. Shu Sun, chair from China, which consisted 9 oral presentations from scientists of China, Fiji, Russia, Sri Lanka, Swede and USA. The topics of these presentations covered ENSO on Asia climate, climate change adaptation in pacific inlands countries, monsoon system, black carbon change, regional patterns of temperature variability in China, aerosol climate, seasonality of climate change, precipitation forecast experiments, and silica fluxes India Ocean, etc.

  The session two presented 10 presentations of Strategic Adaptation to Global Change. Prof. Nishioka Shuzo from Japan and Prof. K. Kosky from Fiji are selected as the chairs of this session. Scientists from China, Fiji, and USA provided broader topics in the session, which including sea level variations, climate variability and change for the pacific island, the impact of climate on agriculture, simulation studies on grass production in China, regional scale modelling on Inner Mongolia grassland, terrestrial ecosystem, climate change of the deserts in north-central China, forest gap model, Leymus Chinensis grassland, etc.

The last session included 7 presentations and was chaired by Prof. Deliang Chen and Prof. Shea Eileen L from USA. Topics like strategic approach of adaptation to Global Change, Indian experiences in sustainability transition, adaptive response to land use and land cover change in the southern coast of Java Island, adaptation of Asia and Pacific to Global Change were introduced by scientists from China, Fiji, Japan, India and Indonesia.

Prof. Congbin FU did the symposium summary as the closing of this symposium. He highlighted the success of this symposium in the past two days and thanked all the participating scientists for their excellent speeches, and then he introduced the on-going Monsoon Asia Regional Integrated Study, which is a new initiative of Global Change Research.

The poster session of this symposium was also held in the duration of the Congress. Students from START TEA-RC presented their research results in the field of the Shift of Climate Zones in China, land-atmosphere coupling model, economic climate, etc.

- **Outcomes and Products**

A proceeding for the symposium 2.1: Adaptation of Asia and Pacific to Global Change consisting of presentations made in symposium 2.1 will soon be published under the support of CAST. Papers related to these presentations will be also published by individual scientists if it is possible.

- **Conclusions**

As the largest symposium in the 20th Pacific Science Congress, the Symposium 2.1: Adaptation of Asia and Pacific to Global Change was a great success, which established a bridge among scientists in the Asia-Pacific regions to exchange the common interests in this field. The presentations and posters of this symposium built up a brief view of the research of the adaptation Asia-Pacific regions to Global Change.

- **Future Directions**

The future direction of this proposal is to raise prepositional projects of further study in APN region. A proposal to put Asia-Pacific Integrated regional Study on the research agenda of PSA was accepted as a resolution of the 20th Pacific Science Congress.

Appendix I

The Program of the Symposium 2.1Adaptation of Asia Pacific to Global Change
Bangkok, Thailand (March 17-21, 2003)

Chair: Prof. Sun Shu,
Co-Chair: Prof. Fu Congbin and Prof. Kasaem Chunkao

Monday 17th March
07:30-08:30 Registration
08:30-09:15 Opening Ceremony of the 20th Pacific Science Congress
09:15-10:00 Keynote 1

10:00-10:30 Coffee Break

10:30-10:40 Welcome Speech by Prof. Fu Congbin

Session 1: Regional Aspects of Global Change in Asia Pacific Region

Chair: Kasaem Chunkao

10:40-11:00 Climate Change Adaptation and the Pacific Island Countries: Capacity Enhancement to Minimise Vulnerability **by Koshy K**
11:00-11:20 Influences of the ENSO on Asian Climate **by Li Chongyin**

11:20-11:40 The Monsoon Systems and Predictions of Their Variabilities **by Zhao Sixiong**
11:40-12:00 Regional Patterns of Temperature Variability in China: 1951-2001 **by Chen Deliang**

12:00-13:30 Lunch

Session 1: Cont.

Chair: Shu SUN

13:30-13:50 Numerical Study of the Aerosol Climate Effects in China **by Luo Yunfeng**
13:50-14:10 The Role of Back Carbon on Global Climate Change: A Perspective from Automobile Industry **by Song Qingyuan**
14:10-14:30 Seasonality of Climate Change in the North Hemisphere Asian-Pacific **by Ponomarev Vladimir**
14:30-14:50 Precipitation Forecast Experiments in Asia-Pacific With a Coupled Air-Sea Model **by Zhao Qigeng**
14:50-15:10 Depletion of Silica Fluxes India Ocean Via Sri Lankan Rivers: Dams-made Effect **by Sliva Etiga**

15:10-15:30 Coffee Break

Session 2: Impact Assessment of Global Change on Socio-economic Development
Chair: Nishioka Shuzo

15:30-15:50 Drought and Flood Disasters and Their Impacts on Agriculture and Economy in China and Surrounding Regions **by Huang Ronghui**
15:50-16:10 Consequences of Climate Variability and Change for the Pacific Islands: Challenges and Opportunities **by Shea Eileen L**.
16:10-16:30 The Impact of Climate on Agriculture **by Lin Erda**
16:30-16:50 Simulation Studies of Impact of Climate Change and Human Activities on Grass Production in China **by Jinjun Ji**
16:50-17:10 A Model Study on the Interaction Between Forest Carbon Cycles and Regional Climate over China **by Li Yinpeng**

Tuesday 18th March
08:30-09:15 Keynote 2
09:15-10:00 Keynote 3

10:00-10:30 Coffee Break

Session 2: Cont.

Chair: K. Koshy

10:30-10:50 Effects Of Climate Change On Terrestrial Ecosystems In China **by Zhou Guangsheng**
10:50-11:10 Recent Sea Level Variations and Trends in the Pacific Region **by Aung Than H**
11:10-11:30 Climate Change of the deserts in north-central China during the last glacial cycle: in relation to the current desertification **by Ding Zhongli**
11:30-11:50 A Forest Gap Model to Simulate Dynamics and Patterns of Far East Forests **by Yan Xiaodong**
11:50-12:10 Response and Feedback of Leymus Chinensis Grassland Ecosystem on Global Change **by Wang Yuhui**

12:10-13:30 Lunch

Session 3: Strategic Adaptation to Global Change

Chair: Chen Deliang

13:30-13:50 Strategic Approach of Adaptation to Global Change **by Nishioka Shuzo**
13:50-14:10 Managing Wetlands for economic and Effective use of Natural Resources in Drought Prone Area: Indian Experiences in Sustainability Transition **by Chaudhari, Lalitkumar pandit**
14:10-14:30 Modeling the Influences of Land Use on Aridification **by Jiang Jing**

14:30-14:50 Selection and Questions of Adaptation Specimens in Changed Conditions **by G. R. Gasanova**

14:50-15:10 The Adaptive Responses to Land Use and Land Cover Change in the Southern Coast of Java Island **by Wijaya Jaya**

15:10-15:30 Coffee Break

Session 3: Cont.

Chair: Shea Eileen L

15:30-15:50 Globalization and Soft Budget Constraint in Diverse Circumstances **by Hannan Kate**

15:50-16:10 Adaptation of Asia and Pacific to Global Change: A study on Carbon Dioxide Emissions and Climate Change Predictions and Impacts in India: Identification of Major Dimensions and Capacity Building for Sustainable Development **by S. Shanmuganandan**

16:10-16:30 **Symposium Summary** - Monsoon Asia Regional Integrated Study – a new initiative of Global Change Research by Chair (Prof. Congbin FU)

Appendix II

Symposium 2.1: Adaptation of Asia and Pacific to Global Change
Bangkok, Thailand (March 17-21, 2003)
List of Participants

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Appendix III

Funding Sources out with APN

The project also receives funding sources from participating countries other than APN: Chinese Academy of Science (CAS), Chinese Association for Science and Technology (CAST), Ministry of Science and Technology of People's Republic of China (MOST).

Funding resources	Amount of Money	Supporting Numbers
CAS	US$10000	6
CAST	US$5000	3
MOST	US$15000	9

Appendix IV

Abstracts of the presentations

Climate Change Adaptation and the Pacific Island Countries:Capacity Enhancement to Minimise Vulnerability

Kanayathu Koshy
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Current climate scenarios place Pacific Island Countries (PIC) amongst the most vulnerable to the projected impacts of climate change. The small physical size, isolation, limited natural and human resources, isolation, high economic sensitivity, high population growth and poorly developed infrastructure contribute to the vulnerability of these island countries.

With very limited mitigatory power to minimise global warming related climate change, the island nations must be prepared to make adjustments in practices and processes to deal with variations and changes in climate. Adaptive capacity enhancement must take place through the broad framework of sustainable development taking environmental and socio-economic considerations into account. This paper will deal with Pacific Island sensitive capacity enhancement requirements.

The main thematic areas identified as focus for attention are: data and information needs for adaptation (results of the project on ENSO and Sugar Production in Fiji will be presented), adaptation mainstreaming and technologies, traditional knowledge (pacific examples), risk assessment and management and observational capacity building (general results of USP/ NASA-NOAA and NIWA projects on ozone and methane together with the AusAID sea level monitoring project will be discussed at some length). Special emphasis will be placed on education, research and training related capacity enhancement efforts in the Pacific to minimise PIC's vulnerability to global change.

The Role of Black Carbon on Global Climate Change
A Perspective from Automobile Industry

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Black carbon (BC) emissions are mostly from biomass burning and incomplete combustion of fossil fuel. BC absorbs solar radiation efficiently (the direct effect), heats the local surrounding and evaporates the cloud droplets (the semi-direct effect) in the lower atmosphere. Because of the absorption by BC, less of the incoming solar radiation reaches the earth> '> s surface, leading to radiative cooling at the local surface but potential warming of the surface elsewhere. Black carbon may also be coated by water-soluble species like sulfates and serves as cloud condensation nuclei and forms small cloud droplets (indirect effects), which reflect radiation and cause cooling. Given the complex interaction of BC with radiation and cloud and the local, non-uniform feedbacks of the atmosphere-ocean system, the climate impact of BC can only be described competently by the coupling of an aerosol and a general circulation model.

There have been many publications addressing the climate impact of aerosols including BC. Two recent papers specifically on the global climate impact of BC aerosols came to our attention. One, by Mark Z. Jacobson of Stanford University and referred to as MZJ, is in press for publication in the Journal of Geophysical Research. It concluded that BC was a significant global warmer, and that abruptly eliminating the fossil-fuel BC and organic matter (OM) annual emissions (15.2 TgC or teragrams of carbon; 1 TgC = 1 million metric tonnes) would reduce global warming by 0.35*C within five years, whereas abruptly eliminating one third of anthropogenic CO2 emissions would have the same cooling effect but after 50-200 years. The author went on to argue that the existing US and European vehicle particulate emission standards and other fuel-related regulations favoring diesel vehicles appeared to promote global warming. The other paper, by Chien Wang of the Massachusetts Institute of Technology and referred to as CW, is presently being revised for publication in the Journal of Geophysical Research. It concluded that the BC at an emission rate of 14 TgC per year, does not contribute to a significant increase in land-surface temperature. By implications, the second paper in effect refutes the conclusion of the first paper.

New modeling results on the climate impact of BC or haze are becoming available. They all predict local cooling of the surface air temperature, opposite to the conclusion of MZJ . The models also indicate changes in regional climate other than temperature, and localized warming elsewhere. The recently conducted Indian Ocean Experiment (INDOEX) provides valuable information against which predictions of BC> '> s climate impact can be checked. The Asian Brown Cloud in the Experiment contains 14% BC and has a very large fossil-fuel component. Significant reduction of solar radiation, up to 15%, was observed at the surface below the Cloud (which occurs during January-April). The increase in observed surface-air temperature had been consistent with the global warming trend during the 20th century, but the temperature trend has leveled off since the 1960s, with a statistically significant cooling of 0.3> *C since the 1970s

during the period with the Brown Cloud. Since the haze effect was very small before the 1960s, the observed result is consistent with the model-predicted surface cooling by the Brown Cloud canceling the model-predicted warming by greenhouse gases. Accordingly, we conclude that MZJ> '> s conclusion on near-surface warming by BC cannot be considered credible at present.

Given that BC has a short atmospheric lifetime (a week, compared to 100+ years for CO2), and that it cools locally and its climate impact is mainly regional and season-dependent, it is more prudent not to aggressively reduce BC emissions to the extent of jeopardizing significant CO2 emission reduction. MZJ emphasizes the immediate benefit of controlling diesel particulate emissions compared to the slow benefit of controlling CO2. We believe just the opposite. In fact, if we indeed find that BC has detrimental climate impact, controlling it will quickly remove the problem. On the other hand, our climate is still responding to the CO2 emitted between now and a hundred years ago. Because of its long atmospheric lifetime, the impact of CO2 on global climate is gradual and incredibly insidious. It allows people to question if global warming is indeed real and lulls people into inaction. But when the evidence of global warming becomes strong and persistent, attempting to r!
everse the warming trend will be very difficult because the impact of CO2 reduction will only gradually show up some decades to centuries later.

According to IPCC 2001, the current BC emission is about 13 Tg, of which 6 Tg is from biomass burning, and 7 Tg from fossil fuel. About a quarter of fossil fuel BC emission is from vehicular emission, 1.65 Tg (Cooke, et al, 1999). Diesel engines are the main source for the vehicular BC emission. However, this portion is expected to decrease dramatically with the implementation of the matured technologies of advanced diesel engine and after-treatment.

The key benefit of diesel vehicles is their ability to reduce CO2 emissions by 15 to 20 percent relative to comparable gasoline vehicles. Use of diesel vehicles in place of gasoline vehicles may serve as a step toward the reduction of CO2. Controlling diesel particulate emissions should presently be based on the potential impact of the particulate on health, not on its potential impact on climate. If stringent exhaust emission controls are necessary such that the energy consumption increases and the CO2 advantage of diesel engines becomes diminishing, introducing diesel vehicles may no longer be viable in helping mitigate the impact of global warming.

Chlororganic Pesticides in Marine Organisms from the Russian Coastal Waters of the Japan Sea

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Persistent organic pollutants are a group of persistent toxic substances. Some of these compounds have received the most attention, among them are DDT and hexachlorobenzene. In general, these chemicals are highly persistent, being concentrated in the food chain, accumulated in body lipids, and imposed human health hazard. They may not only lead to losses, but also lead to the appearance of new genes and ecotypes, resulting in changes of structural and functional biodiversity. Thus, they not only influence mono species, but also population.

Persistent organic pollutants as a hydrophobic compounds are able to disrupt hormonal metabolism, could bind to a cell's hormone receptor, modifying the functions and genetic mechanisms of the cell, causing a wide range of effects, from cancer to nervous disorder and to birth deforming.

The regional investigations of persistent organic pollution are necessary due to: a) identification of sources of persistent toxic substances in the region; b) assessment of impact of pesticides on human health and environment; c) assessment of transboundary pesticide transport; d) identification of regional and global priority of pesticides environmental issues.

The aim of this study is to determine the content of DDT and its metabolites and hexachlorcyclohexane (HCCH) and its isomers and heptachlor in organs of some species of sea fish and birds within the area of the Tumen River influence. Tumen River is the greatest river of Japan Sea basin. It's border of three States: China, North Korea and Russia. 70% of river's territory belongs to China, 30% to North Korea and less 1% to Russia. Russian part of territory is covered of water and marshes, which are used for rest and food by many species of birds during seasonal migration. Marine ecosystems had mainly influenced by waste of chemical undertaking, agriculture and mine are situated on river's bank. In last case the main component of waste are chlororganic pesticides, which accumulate in soft part of marine organisms and influence on their physiological state. Pesticides - three isoforms of HCCH and DDT and its metabolites - were detected with gas chromatography in organs of bottom (Myoxocephalus brandti) and pelagic (Clipea pallasi) fishes, sea birds (Clangula haemalis) and crustaceans. In December 2000, a mass death of Red List spesies cinereous vulture *Aegypius monachus* was noted in this area. A high level of chlorinated pesticides was detected in the organs of dead birds including heptachlor, which was not recorded earlier in the natural environment of southwestern Primorye, Russian coastal waters of the Japan Sea. The values of DDT/DDE and α-HCCH/γ-HCCH coefficients suggest both long-term and considerably recent delivery of these toxicants to the marine organisms. The concentrations of organochlorine compounds

in organs of the fish were 0.1-6.0 ng/g wet weight. In spite of prohibition against using DDT this toxicant is still present in the Tumen River basin ecosystem. The results obtained indicate a greater necessity of monitoring of the content of persistent organic compounds in this region, as an important component of the global changes in the environment.

Managing wetlands for economic and effective use of natural resources in drought prone areas : Indian experiences in sustainability transition

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Wetland is the key to development of the agricultural as well as social and economic development of the coastal areas. Aquaculture is such an innovative tool for wetland utilization in both, urban and also in rural agriculture to use and reuse the coastal wetland, mangrove, tidal water as well as waste reducing adverse environmental impacts.

The countries in the Asia-Pacific region have vast and varied Aquafarming resources. Oftenly these are the main sources for socio-economic development in this region .The overuse of water because of political and social decisions causes salinity and water logging problems in many countries reducing the cultivable area due to formation of coastal wetlands resulting reduction in aquacultural production.

An attempt has been made in this paper to develop the plan for coastal wetland management for the agriculture, aquaculture and horticulture using innovative technologies from Indian experience in sustainability transition. The paper also evaluates the role of knowledge for sustainability for increasing the agricultural productivity in coastal wetlands.

The Adaptive Responses to Land Use and Land Cover Change in the Southern Coast of Java Island

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Java Island poses focal point of Indonesia's rapid activities. Local environmental changes have been occuring in the most valuable wetland of southern part of Java Island. The estuarine wetland has been dwindling due to land use and land cover changes of the upper part of the watershed. The changes of the estuary cause impacts of biogeochemical and human dimension disturbances. It is predicted that the dwindling of the estuary has intensively occurred since more than two decades ago. Based on Landsat Imagery data, the decreasing of the estuary in the last five years was on the average of 2,000 hectars annually. Human dimension contributes driving forces to land use and land cover changes in the upper part of the estuary in one hand and the other hand causes adaptive response to the changes in the estuary. Analysing human responses to environmental changes in the estuary area poses primary key in better understanding of adaptive responses to global change.

Building Taxonomic Capacity in Bangladesh for Conservation of the Biodiversity

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Bangladesh being a sub-tropical country has been blessed by a rich biodiversity. Although a good number of taxonomists, biodiversity research workers and amateur conservationists are working for the conservation of the biodiversity, yet no concrete effort has been taken so far to build taxonomic capacity in this country. There is a National Herbarium established a few years ago and have a number of taxonomists working. Recently, a research group named Biodiversity Research Group of Bangladesh (BRGB) has been formed with members from all disciplines of biological sciences working in different institutes around the country. Among them are a good number of taxonomists who are dedicated to train young taxonomists. BRGB, in collaboration with BioNET-INTERNATIONAL, is proceeding towards establishment of SACNET in the region. A proposal to establish a National Natural History Museum has been submitted to the MoEF of the Government of Bangladesh. These activities will help build taxonomic capacity of Bangladesh and to become self reliant in the field of identification of species and conservation of the biodiversity.

Depletion of Silica Fluxes into Indian Ocean via Sri Lankan Rivers: Dams-made Effect

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Sri Lanka is an island nation in the Indian sub-continent, which has no natural lakes but 103 perennial and seasonal rivers drain the entire landmass in a radial pattern discharging 39 % of the surface precipitation into the Ocean. At present 6,873 MCM of river water has been tapped in low land irrigation tanks and cascading highland hydropower reservoirs which have inundated about 1000 km^2 of the island surface area (65,525 km^2). A majority of these reservoirs are rich in filamentous diatom, *Aulocosiera granulate* and the bio-assimilation of silica results in a significant loss of dissolved silica within the reservoir system. The gradients of dissolved silica from headwaters to downstream were measured four times in three river systems namely Maha Oya, Deduru Oya and Mi Oya located ad jointly to determine whether the fluxes have been affected by the constriction of reservoirs across the rivers.

Irrespective of the size of the watersheds and their geographical locations, the Maha Oya, which has not been regulated by constructing dams and has the 39 % of discharge of the total precipitation volume carries the highest amount of dissolved silica (8320 t yr^{-1}) into the Ocean. The Deduru Oya, which has the 1.73 times of the Maha Oya watershed (1510 km^2) and the 34 % of discharge of the total precipitation volume empties 4529 t yr^{-1} of dissolved silica while the Mi Oya which has the similar watershed area of the Maha Oya but the least percentage discharge of the total precipitation volume (16 %) discharges about 2035 mt yr^{-1}. The silica leaching in the Maha Oya watershed was 5.509 t km^{-2} yr^{-1} while it was 1.731 t km^{-2} $yr^{-1}$and 1.342 t km^{-2} yr^{-1} in the Deduru Oya and Mi Oya respectively. These preliminary results indicate that the silica leaching is primarily determined by the annual precipitation volume and its parentage discharge but the retention is favoured by the presence of manmade reservoirs.

A study on the impact of land cover change on regional climate over China by using the RIEMS and remote sensing data

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The feedback of land cover to regional climate is statistically investigated by calculating the correlation coefficients between monthly average NDVI (14-year NDVI data) in spring or previous winter and monthly mean temperature or rain (50-year meteorological station data from the China Meteorological Administration) in summer. The main results include: (a) The vegetation in previous season has positive effects on precipitation in most regions of China. When NDVI in spring or in previous winter increases, the precipitation will be increased in summer in these regions (Tables 1 and 2). (b) Over three regions (Tibetan plateau, eastern arid/semi-arid region and Central China), the response of regional climate, especially precipitation, to land cover in previous season is sensitive. If impact of snow is not considered, eastern arid/semi-arid region is the most sensitive region among eight regions of China. (c) The vegetation in previous season has a better relationship with precipitation than temperature, possibly because the human activities partly cover up the correlation between vegetation and temperature. These results may reasonably explain many problems that could not be clearly understood by case studies.

Then the impact of large changes in terrestrial ecosystem in East China (30-40^{o}N, 110-120^{o}E) which is showed in Fig.1 on regional water balance is analyzed using the regional environment integrated modeling system(RIEMS). We quantitatively estimate effects of land cover on regional water balance. After crop land is replaced by mixed forest in East China, the parameters except for the upper layer soil water in surface water budget are increased by 2.4%-47.8%(table 3). The result about precipitation (Fig.2) is coincident with previous remote sensing data results. Furthermore, the mechanisms of effects of vegetation change on regional climate are studied. After land cover in East China changes, the east wind component of South China Sea monsoon near Bohai Gulf and Shandong is increased, so as to bring more moisture to land, especially vegetation change region, and the precipitation increases. The warm low pressure located in East China deepens and the subtropical high over western Pacific Become weak after the conversion of vegetation type, and more moisture converges to East China. At last, the effects of vegetation factors on regional climate are discussed.

We note, it is a good selection to study the effects of land cover change on regional climate by using both the regional climate model and the statistical method.

Effects of Climate Change on Terrestrial Ecosystems in China

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The prediction of overall trend in the life-supporting environment of China and the study of the adaptation and mitigation strategies of Chinese terrestrial ecosystems to global change have been emphasized by Chinese government in order to ensure the social sustainable development of China in the 21st century. As one of the sponsor countries of the International Geosphere-Biosphere Programme(IGBP), up to June, 2000, more than 380 projects on the study of global changes have been launched by natural science foundation of China(NSFC), amounting to 141.4 million RMB yuan; about 360 projects related to 275.5 million RMB yuan have been set up by State Science and Technology Committee(SSTC), Chinese Academy of Sciences(CAS), and other ministries. Such huge putting of manpower, material resources and financial capacity has been greatly promoting the global change studies in China and results in their great successes.

This report will present the main research results related to the effects of global change on Chinese terrestrial ecosystems from the following aspects: (1) Adaptation and adjustment mechanisms of dominant plant species to global change, including doubled-CO2 concentration, rising temperature and water stress. Especially, the different effects of doubled CO2 concentration on C3 and C4 plants is explained by ultra-structure of chloroplasts displayed mainly in the configuration of thylakoid membrances and the accumulation of starch grains. (2) Responses of typical terrestrial ecosystems to global climate change. Especially, effects of climate change and land-use practices on the key characteristics of typical terrestrial ecosystems, including plant species number, soil C, total soil N and above-ground biomass, were analyzed. It implies that land-use practices may result not only in quantitative responses' changes but also in qualitative changes in the structure and function of ecosystems to climatic change. (3) Advance in integrated study during recent years on the northeast China transect (NECT), one of the fifteen IGBP terrestrial transects. The achievement includes: developing NECT database; primary elucidating the responsible mechanisms of typical terrestrial ecosystems (forest, meadow steppe and typical steppe) along NECT to global change; establishing quantitative relationships between vegetation and several pollen taxa in surface soil for past global change studies, multi-scale coupling ecosystem dynamic model of Leymus chinensis grassland, and gap-based forest ecosystem dynamic models; and preliminary predicting the possible effects of global change on NECT. (4) Prediction on vegetation structure/distribution and net primary production of Chinese terrestrial ecosystems under global climate change. The reactive tendency under global warming of the Tibetan Plateau, as one of a few regions in the world less affected by human activities, shows the increase in mountain forest, alpine desert, melting permafrost, uplifting alpine snowline, and the decrease in alpine meadow, steppe, the areas of glaciers and lakes on the plateau.

Considering the financial and man-power conditions of China and its special eco-environment, some key science problems will be emphasized in this report, especially ecological processes/ecological security and their responses to global change and integrated study on carbon cycle and water cycle in land.

The Role of Continental Margins in Global Carbon Cycle

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Global carbon cycle is one of the three main themes (carbon, water and food) of global change studies in the next at least ten years. A few years ago when JGOFS finished its field experiment one realized that the ocean could not absorb 3Gt C/yr as originally expected at the beginning of JGOFS, and that only could 2Gt C/yr be absorbed by the ocean annually. And then a missing term (sink) of about 1 Gt C/yr in the global carbon cycle turned out and people started to look for and to determine the place where the 1 Gt C/yr goes. Some deemed that terrestrial ecosystem is the main designation for the missing sink, while others claimed that the global continental margin is the key area to receive the missing carbon. Recently, the majority made a series of assumptions, including the continental margin is a week sink of atmospheric carbon dioxide of 0.1 Gt C/yr in their models to force the global carbon cycle closed with very high uncertainties, especially the one for terrestrial ecosystem.

In the present paper with the East China Sea as an example it is showed that the spatial and temporal distribution of air-sea flux of carbon dioxide is of tremendous variation and not uniform at all. So far there are only three continental shelves where partial pressures of carbon dioxide were directly measured, the Baltic Sea, the East China Sea and the North Sea. Then a conclusion we have to come to is that to estimate and determine whether the continental margin is a sink or source of atmospheric carbon dioxide, reliable direct observations of partial pressure of carbon dioxide on the continental shelves must be made.

Regional Patterns of Temperature Variability in China: 1951-2001

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Climate varies at a variety of spatial and temporal scales. Proper analysis based on appropriate observed data can give us insight into the dynamics of the dominant scales. This study focuses ob regional scale climate variability by using instrumental data in China. The main characteristics of spatial and temporal variability of the temperature regime in China were studied by using the long-term monthly data (1951-2001) at 160 stations. The data were filtered by using Empirical Orthogonal Function (EOF) analysis, which provides principal modes of both spatial variability and time coefficient series describing the dominant temporal variability.

The times coefficients were then subject to standard time series analysis. Statistically significant upward shifts in the time series associated with the first EOF have been found, which is consistent with the global warming trend. The regional patterns of the EOFs, on the other hand, show a profound regional difference. This underlines the importance of a regionalized analysis. Combining rotated EOF analysis with cluster analysis, six regions with similar interannual variability were objectively identified. For these regions the standardized monthly temperature anomalies were computed and analyzed.

Geological Evidence for Spatial Viariation of the Younger Dryas Event

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The Younger Dryas chronozone, recognized in northern high latitude areas as a cold event between 11,000 and 10,000 ^{14}C yrs BP (12,900 – 11,600 cal. yr. BP), seems to manifest itself globally in different ways. Here, we examine well-dated stratigraphic sequences together with high-resolution proxy data plots from sites across our study area, the arid/semi-arid transition zone in northern China. This climatically sensitive area of China records a cold, dry Younger Dryas climate, which was punctuated by a brief period of summer monsoon precipitation. We have since found that similar climatic sequences have been reported from the Sahel and the equatorial region of Africa. Based on evidence from these sites, together with other published data, we postulate that precipitation during the Younger Dryas chronozone was indicative of a low-latitude driving force superimposed on the high latitude cold background. This rain belt rearrangement was most probably caused by an interaction between cold air advection and summer moisture transport across the tropical Pacific Ocean. Examination of high resolution proxies suggest short-term climate fluctuations indicative of a large scale teleconnection involving moist air transportation patterns from the tropics to higher latitudes, varying with ENSO and other tropical factors.

Economic effect of climate change on CHINAESE agriculture

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Agriculture was one of the first economic sectors studied in climate impact research because of its importance to human survival and its sensitivity to climate. Although a few studies provided a methodological basis for studying the agricultural impacts of climate change in America, there are some shortcomings. And in CHINA this research is empty. This paper proved analyses of the economic of climate change on agriculture to address the limitation found in existing studies. In particular, this projects work is focused on (1) Describes the climate change and economic scenarios that were used in CHINA. (2) Presents the predicted impact on the yield of crops and crop migration potentials. (3) Reports the economic impacts on prices, production, and welfare. (4)Represents production and consumption of primary agricultural products. Both domestic and foreign consumption (exports) are
included. Concludes with a summary of findings and a few observations. The analysis is mainly use of statistics. The result suggests that we should adjust our agriculture to adapt to the climate change.

Key words: global warming; agriculture; economic impacts; production and consumption

Water Cycle and Sustainable Development of Water Resources in the Yellow River Basin

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The Yellow River, or Huang He, is one of most important rivers in China. 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. The total length of the river's main course amounts to 5464km with a vast drainage area of 752443km^2. There are about 20 million hectares of arable land, and more than 100 million people inhabit the basin. Throughout history the river can be seen as the cradle of Chinese civilization. However, Most part of the of the Yellow River basin is in the semi-arid regions. Although its area of the drainage basin covers large extent in this country, the runoff makes up only 2% of the national total.

Theoretically, water cycle and water balance is one of the basic scientific issues for the studies on hydrology and water resources sciences. Author of this paper aligned the water circulation mechanism and water resources renewable capacity and dealt with duality model on water resources. The maintenance of renewable capacity and multi-dimensional and synthetic modulation of several critical values is discussed in the present paper. The author pointed out that sustainable utilization of the water resources must be realized. In the same time, the changing mechanism of a water-and-silt process resulting in river flow withering mechanism and the formative mechanism which enables a small floods to cause destructive calamity. A series of workable measures for rehabilitating the basin's depleted ecosystem and a channel capacity to accommodate thr floods is advised to develop. On basis of hydrological cyvle and the rational utilization of water resources, studying the water resources evolving law would realize the sustainable development of water resources in Yellow River Basin and would be of great significance in both science and practice.

Simulation studies of Impact of climate change and human activities on grass production in China

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Semi-arid grassland occupies in a wide range of area in Asian mid- latitudinal zone, a climate- ecosystem transitional zone, whose grassland production is very sensitivity to climate change. In this paper, we studies the impacts of both climate change and grazing on grassland production by use of and Atmosphere- Vegetation Interaction Model, which is a physical –ecophysiological land surface model to be able to simulate both energy and matter exchange and plant growth processes. The main results of the simulation for semi-arid grassland in East Asia can be summarized as follow:

1) Temperature rising leads to the enhancement of respiration and evaptranspiration and decrease in soil moisture and then the reduction of photosynthesis. For semi-arid area grassland is sensitive to soil moisture, therefore grassland productivity decreases vise versa.
2) The increase in precipitation results directly the increase in soil wetness and then results to the increases of grassland photosynthesis and production.
3) Grassland productivity depends on the strength of grazing. Appreciate grazing could reach to a balance between the grassland productivity and livestock capacity. Overgrazing leads to continued decrease in production and desertification.

The Oasis and Desert Effect in a Simple Model Coupling Land and Atmosphere

Lingyun Wu, Jiping Chao, Congbin Fu

In this paper, we construct a coupling system of the oasis and atmosphere based on Pan's oasis evolvement model to discuss the problem of the oasis evolvement and its effects on regional climate. The results indicate: the range of the temperature anomalies becomes large when the oasis areas increase, whereas it becomes small in the desert no matter in summer or winter. The relationship between the surface albedo and the temperature anomalies is linear, while the relationship between resistance of stomata and the temperature anomalies is parabola. In this study, we also discuss different climate and vegetation condition have effect on oasis extensibility and reduction. The results indicate that major condition of extending the oasis is that the vegetation has higher conditional temperature and smaller resistance of stomata. The simple theoretical analysis is helpful to develop complicated numerical model and observational arrangement, and may control the desert.

The Changing Trend of Extreme Temperature in Northern China within Recent 50 Years and The Relationship Between It and Regional Warming

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Based on daily mean surface air temperature from 110 observation stations in China, the changing trend of occurrence frequency and intensity of extreme temperature in northern arid and semi-arid regions within 50 years has been analyzed. While the changing trend and geographical distribution of extreme temperature frequency is analyzed, the changing trend and regional difference of annual extreme temperature variation is given as well. Finally, the temporal and spatial characteristics of extreme temperature and the relationship between them and regional warming are discussed. The results point out: in northern arid and semi-arid regions, occurrence frequency of minimal temperature from 1951 to 2000 decreases remarkably, however, the beginning time of this trend is not the same in different regions. And different from those above, the occurrence frequency of maximal temperature has no obvious changing trend within 50 years despite the evident increase in latest decade, but the maximal temperature in most regions before the 90s of 20^{th} century shows no obvious changing trend. The results from research on annual extreme temperature demonstrate that in northern regions, the annual minimal temperature has an obviously decreasing trend, but the annual maximal temperature has no evidently changing trend even with a decreasing trend in the west of northwestern China. Judged by statistical data of days below zero degrees in each region, the days below zero temperature in northern regions decrease in recent 50 years, and the beginning time of zero temperature falls behind and the end time of it advances. Besides, by studying the occurrence frequency of extreme temperature and the relationship between annual extreme temperature and regional warming in northern regions reaches the following conclusions: the current warming trend is closely related to the decrease of occurrence frequency of extreme minimal temperature and the raise of annual minimal temperature. The maximal temperature increase in latest 10 years enhances the warming intensity.

Key words: extreme temperature, frequency, changing trend, zero temperature, regional warming, correlation.

The northward shift of climatic belts in China during the last 50 years and the corresponding seasonal responses

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Along the meridian of 105º, we divide Chinese region into two parts as the east part and the west part. The results show that in the east part of China the temperate extratropical belt, the warm extratropical belt, and the northern subtropical belt shift northward significantly, whereas the middle subtropical belt and the southern subtropical belt have less or no change. The maximal northward shift can reach 3~4 latitude. In the west part of China, every climatic belt changes seldom. Correspondingly, we have found that in the last 50 years the traditional seasons have changed. For Beijing and Hailaer and Lanzhou, in general, summer becomes longer and winter shorter over the last 50 years. Summer begins early and ends late with respect to 1950. Contrary to the summer, winter begins late and ends early with respect to 1950.

A Model Study on the Interaction Between Forest Carbon Cycles and Regional Climate over China

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Forest carbon cycles are the most important components of global carbon cycles. The climate background determines the attributes of regional forest carbon cycles. However the forest carbon cycles give significant feedback to the regional climate variability. The forest cover distributes more than 1Mkm^2, not only plays a very important role in the regional carbon cycles and environment over China, also gives a significant influence to the regional climate. An Atmosphere–Vegetation Interaction Model (AVIM), which can simulate the interaction between the land physical processes and ecosystem carbon cycles processes, is applied to simulate the interaction between forest carbon cycles and regional climate over China. In order to gives relative finer estimation of the forest carbon cycles, 1 km resolution forest cover, soil data and daily site observation climate data are selected as input. The seasonal and inter-annual variation of carbon cycles variables, include: NPP, NEP, carbon storage in the biomass and soil organic matter of the forest are estimated. The energy exchange between atmosphere and forest ecosystem are analyzed.

Understanding Vulnerability to Environmental Change as a tool for Adaptation

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The vulnerability definition is apparently an easy concept to understand but it is very difficult to quantify. Recent literature presents a suite of definitions, some of them misleading and contradictory. Downing *et al.* (2001) proposed that vulnerability is more directly concerned with the consequences and not with the causes of a particular hazard or extreme event over a group or unit of concern, as for example famine vulnerability instead of drought vulnerability; population vulnerability instead of floods vulnerability, and so on. In this presentation the concepts associated with the vulnerability definition: hazard, risk, resilience and the vulnerability concept itself will be discussed. Some examples will be presented on how to explicitly quantify the vulnerability condition. These examples encompass different scales from local to global since vulnerability is inherently a scale dependent concept. An important aspect is the accounting for the uncertainty in the vulnerability estimates and methods to incorporate this uncertainty will be highlighted as an important previous step for risk estimation. Finally the use of these estimates as a useful and important information for stakeholders and policy makers to understand and prioritize the adaptation measurements required to increase resilience to environmental change will be also discussed.

Precipitation forecast experiments in Asia-Pacific with a coupled air-sea model

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An important aspect of climate variation is precipitation variation which impacts on environment change and economy development. To provide seasonal to interannual prediction (SIP) of precipitation and sea surface temperature (SST) anomaly a coupled ocean-atmosphere model has been developed. It is consisted of Indian-Pacific ocean model (IPOM) and global atmosphere model (T63_NCC). IPOM covered Indian Ocean and Pacific (25E-70W, 35S-60N). Its horizontal resolution is 1/3°~1.0° by 1.5°. There are 31 levels in vertical, 22 levels above 400m. T63_NCC includes 16 vertical levels.

The flux exchanges between air and sea are performed each day. The atmosphere model T63 takes SSTs from IPOM inside its domain, and takes from climatology outside it. IPOM gets wind stress and heat flux from T63. But the freshwater flux is calculated with Newtonian damping scheme. There is not any flux correction in the coupled integration. Because the domain and grid between T63 and IPOM are different the grid interpolations are needed for each coupling time step.

The main objectives of the coupled forecast experiments are limited in china summer precipitation and SST anomaly in the tropical Indian Ocean and Pacific. The forecast experiments are performed starting on Feb. and ending on Dec. each year. The initial conditions for ocean model takes from the simulation of IPOM forced with observed wind stress. The atmospheric initial conditions are from real time analysis and assimilation with T63.

The primary results from the coupled model show that climate shift is not significant comparing with annual variability. In order to minish the systematic errors the model's predictions are corrected removing monthly mean errors

The experiment forecasts for summer rainfall and SST have been performed for two years. The predictions (Mar. to Sep.) in this year have been provided to the meeting on summer forecast in Apr 2002. The Validations in past months show that SST anomaly pattern forecast (weak warm event) in summer is right; the spring rainfall pattern forecasts in China are not bad, but for different months are different.

The experiments suggests following:

1) SIP is in experiment phase in present. ENSO prediction is right this year; but precipitation prediction is not very well.

2) To combine dynamic and statistic methods is necessary in practicing SIP.

3) We have more things to do for SIP:

a) improving component model and coupled scheme

b) improving observing systems and analysis assimilation methods.

c) improving calculation methods and increase computer power.

Drought and Flood Disasters and Their Impacts on Agriculture and Economy in China and Surrounding Regions

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China is located in the East Asian monsoon region, where the interannual and interdecadal variations of climate are quite prominent, the climatic disasters occur frequently and seriously. In this paper, the spatial and temporal distribution characteristics of drought and flood disasters in China and surrounding regions are analyzed from the observed data of precipitation and surface air-temperature for 50 years from 1951 to 2000. The analyzed results show that flood disasters mainly occur in the Yangtze River Valley and the Huaihe River Valley, and influenced by Asian monsoon, the occurrence of the flood disasters exhibits the characteristics of quasi-biennial oscillation in China, Japan and Korea. The results also show that serious drought disasters frequently appeared in the Yellow River valley and North China since the late 1970's, especially the drought disasters became more severe during the period from the late 1990's to the beginning of the 21th century.

The drought and flood disasters have an important impact on the development of economy in China. The serious drought and flood disasters have caused great damages to agricultural and industrial productions and economy in China. Each year of the 1990's, the broad-scale droughts and floods caused the decrease of grain productions of about 20 billion Kg and the economic losses close to 20 billion RMB yuans (Chinese yuans), approximately 3-6% of GNP of China. Moreover, the damages become more and more serious with the development of national economy. In the summer of 1998, the extremely serious flood disaster occurred in the Yangtze River valley brought a particularly huge economic losses of over 260 billion RMB yuans and death of over 3000 people. Moreover, the persistent droughts occurred in North China have caused the severe decrease of water resources in this region and the increase of drying-up days of the Yellow River. These have led to the severe lack of water resources in North China. Thus, the severe lack of water resources has become into a severe problem limiting the sustainable development of agriculture and industry in North China.

Moreover, the drought and flood disasters and their impacts on agriculture and economy in Southeast Asia are also discussed in this paper.

Besides, the predominant causes of drought and flood disasters in China and surrounding regions are discussed from the viewpoint of the sea-land –air interactions in global climate system, especially from ENSO cycle and the thermal variation of the West Pacific warm pool.

The results show that the occurrence of drought and flood disasters in China and surrounding regions may be closely associated with ENSO cycle and thermal variation of the West Pacific warm pool.

Consequences of Climate Variability and Change for the Pacific Islands: Challenges and Opportunities

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The author will present key findings and recommendations from an initial assessment of climate impacts and response options for Pacific Island jurisdictions[1] conducted as a regional contribution to the first U.S. National Assessment of the Consequences of Climate Variability and Change. The Pacific Islands Regional Assessment began in September 1999 and concluded with the October 2001 release of the final report entitled: Preparing for a Changing Climate: The Potential Consequences of Climate Variability and Change for Pacific Islands. The Pacific Islands Regional Assessment addressed two, mutually supportive objectives:

> Develop a more complete understanding of the regional consequences of climate variability and change for Pacific Island jurisdictions; and
>
> Initiate and sustain an interactive dialogue among scientists, businesses, governments, and communities in the Pacific Region designed to promote the use of climate information to support practical decision-making.

The results of analytical studies, two major workshops and small-group discussions in key sectors provide insights into Pacific Island vulnerability in key areas (sustaining tourism, providing access to freshwater resources, sustaining agriculture, conserving coastal and marine resources, protecting public health, ensuring public safety and protecting community infrastructure. The author will focus on opportunities to enhance the resilience of Pacific Island communities, governments and businesses in the face of climate-variability and change.

[1] This project focused specifically on U.S.-affiliated Pacific Island jurisdictions including the State of Hawaii, Guam, the Commonwealth of the Northern Mariana Islands, American Samoa, the Republic of the Marshall Islands, the Federated States of Micronesia and the Republic of Palau.

Influences of the ENSO on Asian Climate

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The ENSO has been regarded as the strongest signal of interannual climate variation and some important influences of the ENSO on atmospheric circulation and climate in the globe have been indicated in serial studies. The climate variations or anomalies in Asia are also closely related to the ENSO. Some fundamental studying results with relation to influences of the ENSO on Asian climate will be given here summarily. It is very clear that the typhoon activity (the frequency number and route way) over the western Pacific, the Asian summer monsoon activity (the onset and variation) and monsoon rainfall (in Indian peninsula and in East Asia), the temperature in summer over the northeastern Asia region and the Asian winter monsoon activity are all influenced by the ENSO. We can be still shown that the influence of ENSO on the Asian climate is not permanent, it has an evident interdecadal variability. It is also indicated that the Asian climate variation is not a simple response of the atmosphere to the ENSO impact because there are multiple factors leading to the climate variation in Asia, moreover the atmospheric circulation and climate anomalies in Asia will affect the occurrence of the ENSO.

Sustainability Science: knowledge, technology and institutions for sustainability transitions in Asia.

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For several decades, health, education and many other indicators of well being have greatly improved in most Asian countries. Economies have grown at dizzying rates, agricultural productivity has soared, and supply of sanitation, electricity and other basic infrastructure has greatly improved for many. At the same time many natural resources have been over-exploited or degraded, air and water quality pollution became serious problems before efforts were made to tackle them, and what were once thought of as just local scale problems may now have trans-boundary, or international, causes and consequences. The remarkable capacity for farmers to adapt to climatic variability or entrepreneurs to succeed in new green markets is sign that there are still many opportunities and substantial inherent capacity to respond to there challenges.

Asia is diverse. As a geographical whole there is little that is both shared and unique to the region. Sustainability transitions in different parts and sectors in the Asian region will not be the same, because the starting points and contexts of change vary widely. Moreover, for many sustainability issues in any given place there are multiple perspectives on the key problems, proximate and underlying causes and what would be considered valid solutions.

Sustainability science, therefore, should expect to be challenged to justify its selection of problems to focus upon. At least as importantly, it should challenge society to re-examine its priorities. A good example of this in Asia is the series of controversies and re-interpretations of the sustainability "problem" of agriculture and forest use in upland watersheds. Sustainability transitions will require greater public participation in how science agendas are set and how findings are used.

A transition to sustainability is not just a matter of getting the latest, or even the most environmentally appropriate, technology. It also requires a much better understanding of human behaviour, especially institutions, sources of knowledge, markets and politics. Achieving sustainability often depends on changing the behaviour of the rich and powerful, both within and outside the Asian region. Institutions are especially important both as drivers of, and responses to, environmental change. They guide, constrain and facilitate human adaptation to challenges from the environment and social system. The knowledge and wisdom required for transitions to sustainability reside in people and in their landscapes and cultural artefacts, as well as in conventional science.

Finally, there is a growing realization that the sustainability of a livelihood, a national development pathway, or a particular land-use system or sector, does not just depend on a set of static quantities, such as finding some optimal mixture or configuration of economic structures, policies, institutions and international relations. It depends instead on a much more dynamic quality of maintaining adaptive capacity and opportunities. The capacity to adapt is crucial because the real world is full of surprises or disturbances and longer-term structural transformations that will test any solution posed for it.

Adaptation Of Asia And Pacific To Global Change: A Study on Carbon Dioxide Emissions And Climate Change Predictions And Impacts In India: Identification of Major Dimensions And Capacity Building For Sustainable Development

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India, the seventh largest country in the world and the second largest in Asia, has a total geographical area of 329 Mha, of which only 305 Mha is the reporting area (the area as per the land records of villages and towns). The mainland stretches from $8^{o}4'$ N to $37^{o}6'$ N and $68^{o}7'$ E to 97^{o} 25' E. It has a land frontier of 15,200 km and a coastline of 7,516 km. The countrywide mean maximum temperature has risen by 0.6 ^{o}C, and the mean minimum temperature has decreased by 0.1 ^{o}C. However, as the result from mean minimum temperature is not statistically significant, they concluded that most of the increase in mean surface air temperature over India is due to the increase in day time temperature. The output from equilibrium general circulation model (GCM) experiments show that the temperature rise in Northern India would be higher than that in Southern India. The output from different GCM scenarios varies substantially, and the average change across India is predicted to be in the range of 2.3 ^{o}C to 4.8 ^{o}C. On the other hand, taking the possible cooling effect of sulfate aerosols into account. Ninety-eight per cent of the carbon dioxide emissions in India are accounted for by energy related activities. Of this, nearly biomass combustion and the balance contribute 48% by the combustion of fossil fuel. The present study is an attempt to analyze the carbon dioxide emissions and its impacts in global change scenario of Indian subcontinent in relation to land use changes and man made activities contributing to an increase in the CO2. The study attempted to derive a conceptual framework based on the findings of the study to suggest the capacity building for sustainable development for India and developing countries. The study was based on the secondary data collected at various levels including the case studies carried out extensively on the impact of CO2 on global climate change at all levels. The data were analyzed with the help of multivariate statistical technique to identify the major dimensions and to quantify the impacts and also facilitate to derive a conceptual framework to understand the adaptation that India is prepared to meet the challenges at all levels.

Climate change of the deserts in north-central China during the last glacial cycle: In relation to the current desertification

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The continuous expansion of the deserts in northern China is currently imposing a tremendous challenge to the social and economic development of the arid and semi-arid regions. In assessment of the causes for the current desertification, the key is to distinguish anthropogenic impact from the natural processes. In general, China's deserts can be geographically divided into two parts: the western desert and eastern desert. The western desert, located west to the Helan Shan mountains, is within the inner drainage basins and has an annual precipitation mostly below 150 mm. Geological evidence from various sediments such as the wind-blown loess sequences has shown that the western desert may have begun to form at least 22 Ma ago. This means that dry climatic conditions may be the major factor controlling the distribution of deserts in that region. However, the deserts east to the Helan Shan mountains has a mean annual rainfall of about 250-450 mm, and in a global perspective, areas with such a relatively high precipitation are scarcely covered by movable sand dunes. Recently, we have studied the environmental changes over the eastern desert region and found that the desert has experienced a wide-range expansion and retreat during the last glacial cycle, in parallel with the variability of the East-Asian monsoon intensity. During the Last Glacial Maximum (~20 ka BP), the greatly-weakened monsoon caused the occurrence of deserts with an area relatively larger than today's, whereas a steppe environment formed over most of the eastern desert during the Holocene Optimum (~8-4 ka BP). Interpretation of the loess-desert sand-paleosol records in the loess-desert transitional region suggests that desertificated areal extent as large as today's over the eastern desert region never occur in the interglacial periods of the past 0.5 Ma. Our results further revealed that the re-activation of the last glacial sand dunes is a major process responsible for the current desertification in this region, implying that anthropogenic activity may be the most important cause for this environmental problem.

Monsoon Asia Regional Integrated Study
----- A new initiative of global change research

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In the current development of global change research, the integrated regional studies (IRS) is becoming an important component of global program. The regional aspects of global change link more directly with the interests of human society. The integrated regional studies will contribute sound scientific understanding in support of sustainable development of the region and to a quantitative understanding of regional-global linkages and the dynamics of the earth system.

The monsoon Asia has been selected as one of the regions of IRS for number of reasons, such as (1) the Asia monsoon – ENSO interaction is a key scientific issue of inter-annual climate variability related to climate disasters in many part of the world; (2) the Asia monsoon system plays crucial role in global hydrological and carbon cycles; (3) Monsoon Asia is a home of nearly 57% of world population and an area of most rapid social and economic development which bring about the strong anthropogenic forcing on the global change, such as land use, industry emission and urbanization,etc.

START has been charged by its program sponsors (IGBP,WCRP and IHDP) to organize a comprehensive project on integrated regional studies of monsoon Asia in the context of global environmental change. The paper will discuss how Monsoon Asia Integrated Regional studies to be developed to meet the requirement of IRS: close collaboration of not only among the disciplinaries of natural sciences, but also between social and natural sciences; integrated studies based on all the advanced techniques, including field experiments, remote sensing and numerical modeling; integration of past, present and future of the earth system so as to address the questions of What will the Asian monsoon region be like in next 50 years? What will be the consequences of these project changes for the welfare of the region? What are the consequences of regional change for the Earth system?

Seasonality Of Climate Change In The North Hemisphere Asian-Pacific

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The main goals of this study are to estimate and compare the centennial/semi-centennial climatic tendencies of surface air temperature and precipitation over the Pacific marginal and continental areas in the subarctic and subtropic zones of Northeast Asia, as well as SST in the Northwest Pacific for all months ofa year. We use the monthly mean time series of surface air,temperature and precipitation at meteorological stations for the period of instrumental observation until 2000 obtained from the NOAA Global History Climatic Network. Monthly SST trends for the second half of the 20th century are estimated using two grid - data sets from different data bases: (1) from the JMA data base for the area 15°-65°N, 110°-180°E with space resolution 2° x 2° over the period from 1945 to 2000 and (2) time series for the same area and resolution 10 x 10 from 1945 to 1989 from WMU/COADS World Atlas of Surface Marine Data NOAAINESDIS/NCDC CD-ROM, 1994. Missing data of meteorological and SST time series in each months was implemented by the statistical method of incomplete multivariate data analysis (Rubin, 1987; Schafer, 1997; Schafer and Olsen, 1998) using EM and AM algorithms. Details of climate change associated with extreme cooling or warming in winter or summer seasons are revealed.

Two methods of the linear trend estimation were applied: (1) the mean-square-root (MS) method based on Pirson's regression and Fisher's test for significance level, and (2) the nonparametric robust (NR) method based on Theil's rank regression and Kendall's rank approach for significance level (Holander, Wolfe, 1973; Hettmansperger, 1984). NR method should be applied to time series with abnormal distribution function related mainly to precipitation time series. Nevertheless, to demonstrate the differences between trends estimated 'by the two methods in cases for different distribution functions of data set we apply both methods to all meteorological and SST time series. Estimation of surface air temperature and SST trends by MS and NR methods yields similar results due to that the distribution function of air temperature and SST time series is close to the normal pattern. The precipitation trends estimated by the two methods are fairly different because the distribution function of the precipitation time series even on the centennial scale usually has a substantial negative skewness and sometimes an abnormal kurtosis. The NR method increases the statistical significance of both positive and negative linear trends in all cases of abnormal distribution with negative/positive skewness and low/high kurtosis. Using this method, we have: found difference between climatic trends of precipitation in moderate latitudes of the East Asia and

subtropical zone.

Tendency of both centennial and semi-centennial warming is mainly found in winter and spring fori most regions in the mid-latitude. The most substantial centennial warming in the vast continental area ofthef mid-latitude band is found mainly for December-March. The semi-centennial/ centennial cooling occurs in South Siberia and the subarctic mid-continental area in June-September. The change in precipitation during the 20th century accompanies air temperature trends in some extensive areas. However, the precipitation trend exhibits opposite signs: in the subtropic marginal Pacific zone it is usually negative (Japan, south of Russian Far-East), and in the central continental-subarctic marginal areas it is usually positive. Most of statistically significant trends are found in fall (October)-early winter (December) in the subtropic marginal Pacific area, particularly over Honshu and Kyushu Islands and in certain months of all seasons in the continental areas.

Semi-centennial tendencies of SST in the Northwest Pacific also have an opposite sign in different vast areas which changes at transition from winter to summer. A positive tendency of the SST predominates in the Kuroshio region and in the northwestern area of the subarctic gyre (region of the Aleutian and Kamchatka Currents) in winter. A negative tendency of the SST dominates in the southwestern subarctic gyre and the offshore area of the subtropic gyre in summer. Thus, analysis of the distribution of the SST trend in the Northwest Pacific has also indicated large-scale areas with opposite sign of trend in the western subtropic and subarctic areas as well as in summer and winter. This is to a large extent in agreement with the distribution of precipitation trend in the subtropic and subarctic Pacific Marginal areas as well as well as the difference between surface air temperature trends in winter and summer and in marginal and continental areas. The processes of interaction between the ocean and the atmosphere associated with climate change in the area studied are discussed. Comparison of the air temperature, precipitation and SST trends in different seasons over land marginal and continental areas as well as in the subarctic and subtropic zones shows general features of the Northeast Asian Monsoon change in 20th century.

Recent Sea Level Variations and Trends in the Pacific Region

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Since 1991 the *AusAID* funded array of climate and sea level observatories has been established in the Pacific region to monitor greenhouse related rising sea level. Under the project 14 Pacific countries are involved and 12 monitoring stations have been set up. The equipment used in the project is capable of observing sea level every six minutes with an accuracy of one millimetre and telemetering that data along with meteorological observations daily to the project base in Australia. Using the project data, recent sea level trends for the last decade have been calculated and that will be highlighted along with the measurements of the vertical land movement of the stations. It is clearly evident that the global average of sea level trends, 1-2 mm per year is not representing the regional and local trends in the region. For example, the sea level trends in Tonga area for the last 10 years is always ~20 mm y^{-1} and more than ten times higher than global average. The results of air temperature anomalies will also be briefly presented from the point of view on climate change. More interestingly, the influences of the severe El Niño of 1997-98 on sea level will be discussed using the barometric pressure anomalies from the Pacific region.

An emphasis will also be made on understanding the difference between project results of *relative sea level* and the forecasted rates of *absolute sea level* rise given by the IPCC Third Assessment Report. These differences are often confused in the reporting of the issues of land losses, crop failures and coastal erosion in the region. It is *relative sea level* that affects the shorelines and impacts on the activities of people living in the coastal areas. The parallel responsibility of presenting the most responsible scientific forecast of the risks of global warming to the Pacific islands has led to a series of others tasks including to the development of curriculum modules for the schools covering both the physical sciences and the social impacts of climate change.

Globalisation And Soft Budget Constraint* In Diverse Circumstances

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In this paper I will concentrate on two issues drawn from a diverse set of circumstances. I will focus on the self-interested entitlement pre.sumed by elites and I will discuss the plight of ordinary citizens in two very different developing countries, The People's Republic of China and The Fiji Islands. I note their frustration and therefore their predisposition for social disorder. ,

In the period immediately before the June 1989 Tiananmen Incident, China's urban citizens had expressed their frustration over the effects of inflation and corruption. However, their leaders were not listening. They were focused on their own factional struggles which had reached the point of creating policy paralysis. In the end disaffected citizens flooded the streets of China's cities.

In Fiji in May 2000 members of a similarly self-interested elite were concerned with the politics of Party factionalism, the form and agenda of the Fiji-Indian led government that had been recently voted into power, and with maintaining their privileged position while social disaffection was building around them. This time it was not urban citizens who took to the streets. It was rural people. Their disaffection meant that they could be mobilised as a 'rent-a- crowd' for opportunistic elite out-riders such as George Speight. A coup and attendant loss of development opportunity ensued.

In China today, in the immediate wake of their country's admission to the World Trade Organisation (WTO), a proportion of rural village house-holds are under threat. Those **I**households will no longer be economically viable. Their members will have no choice. They i will have to migrate to the cities. Membership of the WTO has come at the free-market price of reducing and eventually phasing out Chinese government subsidies to agricultural ; .producers. Today, in China as in Fiji, it will be rural people who pay a price for globalised \ neo-liberal priorities. i..

In Fiji corruption among the elilte is predicated on perceptions of economic entitlement J; combined with the soft budged opportunity driven by the push to privatise government: holdings and access to aid donations subject to soft accounting procedures. This corruption on the back of globalised reform and aid requirements denies ordinary citizens, particularly rural villagers, the services they could have otherwise had. Fijian villagers have their land, but often this is an excuse to provide little else. It underpins a subsistence economy and, at the same time, it ensures the continuation of a 'traditional' system that acknowledges rank and political and economic entitlement for an elite that is glad to accept.

In China in the 1980s, the soft-budget constraint that plagued the banking system allowed ecessive funds to be drawn. This situation led to economic expansion, inflation and corruption and fuelled much of the dissatisfaction expressed in the first months of 1989. Today, this is not the problem. The process of reform has moved on. Today, China's membership of the WTO will mean that poor rural households will be the victims of globalised free market requirements. For the purposes of this paper a soft budget constrint will be considered to be a budget constraint that does not bind. Cost over-runs are usually met from government or aid donor.

Modeling the influences of land use on aridification

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By using the Regional Climate Model (RegCM2), the effects of different land use pattern on the aridification are simulated. The fictitious numerical experiments are integrated from May 1 to August 31 in 10 years from 1986 to 1995. The western of Northeast China, the eastern of Inner Mongolian and part of North China are used as the test area of land use, which is the transitional zone of the climatic and the ecological system.

Based the fictitious numerical experiments of the land use pattern, the following conclusions are gotten. The change of land use pattern can result in the change of the monsoon circulation, and produce the obvious environment effect. The excessive land use in the transitional zone of the climatic and the ecological system will make the East Asia summer monsoon to maintain at the south latitude, which will accelerate the aridification in the northern of China. The different proportions of land use will have the different influences on the aridification in China, and it is also different under the different circulation.

The Monsoon System and Predictions of Their Variabilities

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The global monsoon systems are considered as consisting of regions with large seasonality. It is discovered that in the lower troposphere there are one tropical monsoon region (coincident with the classical monsoon region), two subtropic monsoon regions (one in each Northern and Southern Hemisphere and occupied by the seasonal migration of subtropical high) and two middle-high latitudinal monsoon regions (associated with the storm tracks of westerlies). Second, the division of seasons is determined by the normalized similarity. It is revealed that in the monsoon regions the transitions from winter season to summer season and from summer to the next winter are abrupt.

Monsoon systems possess larger variabilities which very much affect the economy and the people life. The development of short-term (seasonal to interauunal time scales) climate prediction system, especially for the monsoon regions. Take the central position in the World Climate Research Program(WCRP). China very actively responded to WCRP, developed a real-time dynamical extraseasonal climate prediction system, IAP DCP-II, which has been effectively applied to practice.

Key words: monsoon, seasonality, season, prediction, dynamical climate prediction

Strategic Approach of Adaptation to Global Change

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1. Adapting to global change in two ways

Human activity is expanding to the level of threatening their own life-supporting system of nature. For re-considering development path to reduce human pressure, and at the same time, preparing for adapting to creeping changes, science is essential, but need to be reorganized toward sustainability of the region.

2. Asian potential and possibility

Asia is growing rapidly accompanying with environmental disruption, such as chaotic urbanization, desertification, water shortage, POPs and global warming. Without environmental deliberations to its development path, the additional investment may lead to environmentally degraded future. But we can wisely use this quick rotation of investment as a golden opportunity to integrate environmental considerations beforehand. Strategy needs to be established, under a common regional vision on sustainable development, based on the geographical and historical background of Asia and the Pacific, for de-coupling environmental pressure from development path and for strengthening resilience to the impacts.

2. How the science needs to be reorganized toward sustainability?

Environmental issues, with big inertia and long time-delay, emerge as conflicts between nature and human being. Integrated application of natural science and social science (and even humane studies) is essential for monitoring changes, perceiving and forecasting risk, giving early warning, finding vulnerability and proposing and evaluating alternative policy options. Science need to be reorganized for this purpose toward:

1) Place-based science: Environment is quite site specific and unique to the spot, and only mobilizing full disciplines of science can solve the complex sustainability issues.

2) Participatory science endorsed by capacity building: Environmental value is recognized correctly only by people living there. They have knowledge on the vernacular and responsibility to maintain it. Also, it is only the wisdom of them that can cope to the sporadic impact of changes, unpredictable within present scientific knowledge. Capacity building for strengthen resilience, fully using indigenous knowledge, is the only one robust way of confronting with unpredictable changes.

3) Integrating to main stream: Environmental consideration should be integrated into the main stream of national economic- and land use plan. Continuous dialogues for advising to policy makers with up-to-date scientific finding will effectively works for this integration.

4) Fusion of top-down and bottom-up science: Global scientific results need to be closely combined with local knowledge (as typically illustrated in the case of adaptation to climate change, GCM and regional impacts).

4) Networking of research society: Even though place-based science is fundamental,

collaboration bears benefit of sharing common experience, expertise and resources complementing each other. Beginning from joint research on small regional common problems, such as trans-boundary pollution and international water, the research network can be effectively expanded to constitute loose but powerful society for sustainability science.

4. Develop regional science strategy starting from existing mechanism

There already exist many regional organizational bases usable for strategic development of sustainability science; sharing common future vision (e.g.; APEIS), communication with policy makers (e.g.; IGES policy dialogues in climate policy), capacity building activities (e.g.; AIACC by START and GEF), collaborative regional studies (promoted by APN/ATART and under bi- and multi-assistance programme). ODA should aim more to scientific capacity building, considering its key role for sustainability in the region.

A brief introduction of some simulated results of aerosol climate effect in China

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In recent decades, the patterns of surface temperature change in China have different characteristics in the world and in some areas near the highly industrialized regions the surface temperature proved to be decreasing, while most of the world has been warming. In addition, there has been a tendency for increased summer floods in South China and increased drought in North China,

In this report, by using both the regional climate model and GCM model, we have done some numerical simulations relative to aerosol's climate effects based on our retrieved aerosol optical depth on China. When considering the aerosol's radiative forcing, the simulated results show that the aerosols may be the reason to cause the temperature mediate cooling. Even more, human made aerosols may tend to increase rainfall in South China and decrease rainfall in North China during the rainy season, in the sense of the observed trend in recent decades, with the aerosol single scatter albedo, SSA = 0.85 in China. the surface temperature response is partly similar to the observational facts.

Study on Soil and Water Conservation Benefit of Land Use/ Land Cover Change -Cases Study in Jianou Niu Kenglong Experimental Station and the Provincial Soil and Water Conservation Station, Fujian Province

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As one of the most important study fields of global change, land use and land cover change has significant impacts on regional and global climate, soil characteristics, the function of terrestrial ecosystem. Most researchers, both in China and abroad, have given much more attentions on the study on land use types and the laws of regional land cover change with synthesis analysis of the factors that influence on land use and land cover change. In recent years, some China researchers have studied in this field by stationary inspection methodology, e.g., Professor Fu Buojie etc., studied impacts of land use and land cover change on soil nutrients, regional hydrological condition in Loess hilly areas and Zunhua low mountainous areas in Hebei province, Professor Shi Peijun etc., studied impacts of land use and land cover change on natural agricultural disasters in Nei Mongolia Autonomous Region on the basis of long period investigation and statistical materials. But few researchers studied that of land use and land cover change on soil and water conservation benefit by stationary methodology, and few papers have been published in this area. This paper studied the impacts of land use and land cover change on soil and water conservation in Fujian mountainous areas on the basis of analysis on long period inspection and experimental materials in Jianou Niu Kenglong Experimental Station and the Provincial Soil and Water Conservation Station, researched soil and water conservation mechanism of mountain grassland ecosystem, and different soil and water conservation benefit under different land use and land cover types, analyzed the variation of soil and water conservation capacity in different periods and different growing stages, constructed the formulas of land use and land cover change with soil and water conservation benefit, designed soil and water conservation models that takes grassland ecosystem as main part and suits for Fujian mountainous areas local physical conditions, put forwards the measures to improve the quality of environment and ecosystem in Fujian mountainous areas.

Key Words: Land use and land cover change Soil and water conservation Quality of ecosystem and environment

New Evidences: Climate Change Impacts On Agriculture with Adaptation In China

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Global climate change due to more greenhouse gases emission by human activities has been concerned for more than 10 years, because it will cause more adverse impacts on many economic sectors and some regions. The expected range of global warming at 2100 based on 35 emission scenarios is 1.4 – 5.8 ℃ (IPCC, 2001). A number of impacts studies show that agriculture, water resources, costal zone and ecosystems are the most influenced area in China due to the similar temperature change trends in most part of China.

It has been proposed the observed impacts of changes in regional climate warming that are relevant to agriculture are related to increasing yield trends in Northeast China, lengthening growing seasons in northern China, improved cotton quality in Xingjiang, and expansion and advanced phonologies of agricultural pests. But a number of simulation studies show that rice, wheat, and corn production would meet adverse impacts due to shorter growth period caused by continuous warming climate, but cotton different. Asia has the world's largest area under cereal cultivation and is the largest producer of rice (FAO, 1999), but by 2010 per capita availability of land in developing countries of Asia will shrink from the present 0.8 ha to about 0.3 ha. Current rates of land degradation suggest that a further 1.8 million km^2 of farmland could become unproductive by 2050, adding climate stress to a system that must ensure food security in the context of a rapidly growing population..

To further understand the potential impacts on rice production in China, the two transient GCMs(HadCM2 and ECHAM)) are being used as the scenarios of climate change, joining the Chinese Weather Generator developed by self and CERES-rice3.5 Model, which were adjusted where necessary to ensure that they could be applied to China to simulate the impacts on the yield. The results show: 1) There will be a reduction trend of rice yield in main rice areas of China both in 2030 and 2056; 2) CO_2 abatement by 0.5% will not change the trends; 3) In the some regions of high altitude where is suitable for rice growth in the future, like in the Southwestern China, rice will show a trend of increasing in yield.

In order to further reduce uncertainties, a new simulation study is carrying out through a UK-China cooperation project. A developed Rice model by Robin Matthews (1999) and similar wheat, corn and cotton models were adopted, in which the spatial simulation mainly was improved. The newest 7 different climate change scenarios are using, which are baseline, 2025, 2050 and 2080 under two emission scenarios (typically A2 and B2 in SRES). All scenarios are simulated by the Hadley Centre's RCM-PRECIS (Providing Regional Climates for Impacts Studies). The resolution of the Regional GCMs is 50KM*50KM. FAO soil data, crop experiment data of 1978-2001 in all China were used, and a long term land use change reflect the social economic scenarios was considered. The more exact mapping results show the larger difference of crop yield distribution with the previous results; even involving adaptation climate change still will result in a reduction of between 5 and 10% in production of main crops in China in the next 30 years.

Key Words: Climate Change, Impact study, Crop simulation, Adaptation