Outline and Progress of the Monsoon Asia Integrated Regional Study

http://www.mairs-essp.org

MAIRS IPO October 2006
Characteristics of monsoon Asia

- Dominated by monsoon climate
- Unbalanced water resource distribution
- Diverse geography and landscape
- Rich in ecosystems and biodiversity
- Long history of civilization and rapid economic development in recent decades
Temperature increase in monsoon Asia in the last 100 years

<table>
<thead>
<tr>
<th>Region</th>
<th>Temperature Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Asia</td>
<td>+ 0.4 °C</td>
</tr>
<tr>
<td>Southeast Asia</td>
<td>+ 0.3 °C</td>
</tr>
<tr>
<td>East Asia</td>
<td>+ 0.84 °C</td>
</tr>
</tbody>
</table>
Temperature change at the Eastern Tibetan Plateau in recent 50 years (from Duan et al., 2006)
Land use/cover change in China during 1990’s

Before

After

Liu Jiyuan et al.(2004)
Ecological and economic damage due to environmental change

“Economic growth in EAP … resulted in dramatic improvements in the quality of life …. The picture, however, is far from entirely positive. **Gains have been unevenly distributed, and rapid economic growth has been achieved at considerable environmental cost.**”

“In virtually all countries … **natural resources have been degraded, often at alarming rates.** Some countries have lost 70 to 90% of their original wildlife habitat.”

“**Environmental services and policies have not been able to keep pace …** as indicated by insufficient levels of access to safe water and sanitation, a dramatic increase in waste generation and unsanitary disposal practices, and serious air pollution impacts. In China alone, air pollution from fuel combustion has been estimated to contribute to the equivalent of 3 to 6 million life-years lost annually.”

Tipping points in the Earth System
The importance of Integrated Regional Studies (IRS)

“IRS can contribute substantially to the reconstruction of the global dynamics from regional patterns; integrated regional studies represent a unique way to reconstruct the Earth System from its components and are thus an essential part of the Earth System Science toolkit.” (Steffen et al, 2004).
MAIRS is the first IRS of ESSP
Vision of MAIRS

“To significantly advance understanding of the interactions between the human-natural components of the overall environment in the monsoon Asian region, and implication of global earth system, in order to support the strategies for sustainable development.”
MAIRS Initial Science Plan 2006

started by MAIRS working groups (April), elaborated and edited by a drafting team (May-August).
Key Questions of MAIRS

- Is the Asian monsoon system resilient to the human transformation of the region’s land, water and atmosphere?

- Are societies in the region more, or less vulnerable to changes in the Asian monsoon?

- What are the likely consequences of changes in monsoon Asia on the global climate system?
Conceptual Framework of MAIRS

Institution     Policy      Law      Education

Mitigation and Adaptation

Regional human development
Industrialization Urbanization Intensive Agriculture

Environment Issues
Biodiversity Water Food Air Energy Disaster

Natural Forcing
Tibetan Plateau Solar Radiation Land/Ocean

Earth System

Earth System

Asian Monsoon System

Atmospheric Chemistry

Physical Processes

Biogeochemical Processes

Biogeochemical Processes

Physical Processes

Atmospheric Chemistry

Asian Monsoon System

Tibetan Plateau

Solar Radiation

Land/Ocean

Natural Forcing

Emissions

Land/ water Use
Resource management issues due to regional and global environmental change

- Water: quality and quantity
- Energy: supply and demand, carbon
- Food security: quantity and accessibility, biofuel
- Biodiversity: environmental services
- Air quality: human health
- Disasters: reducing impacts and prevention
MAIRS integrates research on these issues in geographic Zones in Asia.

Four hot-spot Zones:
- Coastal Zone
- Mountain Zone
- Semi arid Zone
- Urban Zone

Cooperation with Issue-oriented projects (e.g. GCP) and global Zone-projects (e.g. LOICZ)
Key points of the Themes

Coastal Zones
Rapid transformation of land and marine resources

Mountain Zones
Multiple stresses on ecosystem and biophysical resources

Semi-arid Zones
Vulnerability of ecosystem due to changing climate and land use

Urban Zones
Changes in resources use and emission due to rapid urbanization
The coastal zone is where the land, river, atmosphere, seas, sediments and biota meet.

Coastal zones of monsoon Asia are unique because they are subjected to the influence of monsoons.

Coastal zones are threatened by combined effects of population growth, urban and agriculture development, industrial expansion, offshore waste disposal, exploitation of freshwater and marine resources, coastal erosion, over extraction of ground water and the impacts of sea level rising.
Dramatic changes in Huang He Delta, China

Images show the mouth of the Yellow River and the emergence of a huge parrot-headed peninsula.

1979-2000: Huang He’s yellow color is the result of huge loads of sediments.

From “One Planet Many People: Atlas of our changing environment”
Land reclamation changes along Isahaya Bay, Japan

1993: Turning tidal lands into farmlands

2003: The area has been fully reclaimed from the sea

From “One Planet Many People: Atlas of our changing environment”
Main research areas for coastal zones

- Coastal morphological change
- Sustainability of coastal resources
- Vulnerability of coastal societies and adaptation
- Coastal zone management

Leading research question:

What affects rapid transformation of land and marine resources in the coastal zones in the context of global environmental change?
Mountains in monsoon Asia have a profound effect on the weather and climate of the region and world, particularly the Tibetan Plateau.

Mountains in monsoon Asia are the sources of major rivers of the region.

The hydrological cycle and ecosystems in the mountain zone are affected by changes in regional and global climate.
Retreating Gangotri glacier

Receding glacier tracked since 1780

In the last 25 years, Gangotri Glacier has retreated more than 850m
In 2004, the distance between eastern and western glacier tail was 45 m and a lake with area about 30 m² appeared between them.
Main research areas for mountain zones

- Hydrological cycle and water resource
- Ecosystem and biodiversity
- Agriculture, forestry and food security
- Extreme events and natural disasters

Leading research question:

What are the drivers and impacts of global environmental change on the fragile natural and human systems of mountain zones of monsoon Asia?
Theme III: Semi-arid Zones

- Water resource and ecosystem service and goods are crucial to the people living in semi-arid regions.

- Semi-arid regions are sensitive to climate variation and human perturbations.

- Semi-arid areas in monsoon Asia are the major sources of dust aerosol.

- Scientists knew little about semi-arid regions due to lacking of observational data.
Global drying trend over last 30 years (Dai, 2004)

Land degradation in semi-arid China

Land degradation in semi-arid India
long distance transport of dust aerosol

10 Apr, 2006, Inner Mongolia

16 Apr, 2006, Beijing

18 Apr, 2006, Tokyo

Observing stations in northwest and northeast China

Lanzhou

Tongyu
Main research areas for semi-arid zones

- Interactions among global warming, monsoon variability and aridity
- Atmosphere, land surface and ecosystem interaction
- Dust aerosols, the hydrological cycle and regional climate

Leading research question:

How will semi-arid zones change in the next decades with respect to water resource, air quality, provision of ecosystem goods and services, extreme events and hazards?
Urbanization is a major driver and outcome of economic and social development.

In 2000, 30% of the Asian population lived in urban areas (47% world average). Of the 10 world's most populous urban agglomerations, 6 are in Asia.

Urbanization in monsoon Asia is occurring at very rapid rate. By 2015, of an estimated 27 megacities (exceeding a population of ten million), 15 will be in Asia.
Beijing has experienced explosive growth since economic reforms in 1979.

- **1978: Beijing in 1978**
- **2000: Extent of urban expansion is clearly visible**

From “One Planet Many People: Atlas of our changing environment”
Rapid urban growth in Karachi, Pakistan

- 1975: Karachi before the urban sprawl
- 2001: Note the change in aerial extent

From “One Planet Many People: Atlas of our changing environment”
Air quality in Asian cities
Main research areas for urban zones

- Energy, emissions and urban air quality
- Urbanization, flood regimes, disaster management
- Urbanization and water security

Leading research question:

What are the impacts of urban landscape change and emissions on the climate system, ecosystem, agriculture and human health?
MAIRS gives particular attention to ‘integration’

in five dimensions:

• Across national boundaries
• Between research disciplines
• Between community sectors
• With different methods
• Employing many data types
Implementation issues for the MAIRS Initial Science Plan

- Data availability and relevance
- Modelling
- Regional studies
- Capacity building
- Regional and international links
- Contribution to sustainable development
Recognizing that MAIRS is focused on scientific research and that sustainable development depends upon complex interactions between science, technology and politics ...

it is expected that the results of MAIRS studies will contribute to national processes aimed at sustainable development.

These contributions will be achieved through communication activities that will be carefully targeted at relevant communities.
MAIRS should provide many opportunities for capacity building and enhance research capability particularly in the institutions and regions where current capabilities are limited.

There is an interest in all countries to develop a capability in modelling.

Approaches:
- development of collaborative studies across the region
- exchange programs to enhance capabilities of individuals
- establishment of undergraduate and graduate studies in ESS in universities across monsoon Asia.
Organization of MAIRS

MAIRS is a new international research Program of ESSP to address the coupled human and natural processes of environmental change.

It was implemented by START on request of ESSP and the GEC-programs. The MAIRS Program is guided by a Scientific Steering Committee (SSC) and supported by an International Program Office (IPO).

The core of the MAIRS Program consists of a working group, with projects, for each of the four scientific Themes, the SSC and the IPO. MAIRS will collaborate with many partners.
MAIRS SSC members

- C.B. Fu (IAP, CAS, Chair, China)
- M. Manton (vice-chair, Australia)
- J. Matsumoto (vice-chair, MAHASRI, Japan)
- A.P. Mitra (vice-chair, START-SA RC, India)
- A. Chen (GCP, China-Taipei)
- P. Kabat (IGBP-iLEAPS, Netherlands)
- T. Koike (CEOP and GEOSS, Japan)
- S. Liu (IGAC, China-Taipei)
- L. Lebel (Chiang Mai University, Thailand)
- F. Penning de Vries (IPO, Netherlands).
- K. Seto (IHDP, Stanford University, USA)
- L. Shao (MOST, China)
- A. Snidvongs (START-SEA RC, Thailand)
Opened in January 2006;

Staff:
- Frits Penning de Vries, director
- Ailikun, deputy director
- Yang Ying, information officer
- Liqin Shao, science advisor

Located at the Institute of Atmospheric Physics, Chinese Academy of Sciences, in Beijing, China.
Activities of the SSC and Working groups are facilitated by an IPO.

The IPO is a small unit to support and advance the MAIRS program on a day to day basis. It functions under the guidance of the SSC.

The IPO is supported by CAS for 10 years (2005-2014), along with MOST.
Next steps (2007, 2008)

- Development of actual projects
- Activating the structures (working groups, collaboration with ESS projects)
- Capacity building
- Resource mobilization
- Regional integration across Themes and Zones
MAIRS related conferences

ESSP OSC Beijing meeting, MAIRS Asian monsoon session and MAIRS evening session, 9-10 Nov. 2006;
Mountain Zone working group meeting (14-17 Nov. 2006, Beijing);
AGU Fall meeting, MAIRS session (land-surface process), 11-15 Dec. 2006, San Francisco, USA;
Pacific Science conference (PSC), 13-17 June 2007, Okinawa, Japan;
Please contact us to explore where and how we can collaborate!

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