

Land Use Land Cover Research Highlights from the MAIRS and NEESPI Science Programs

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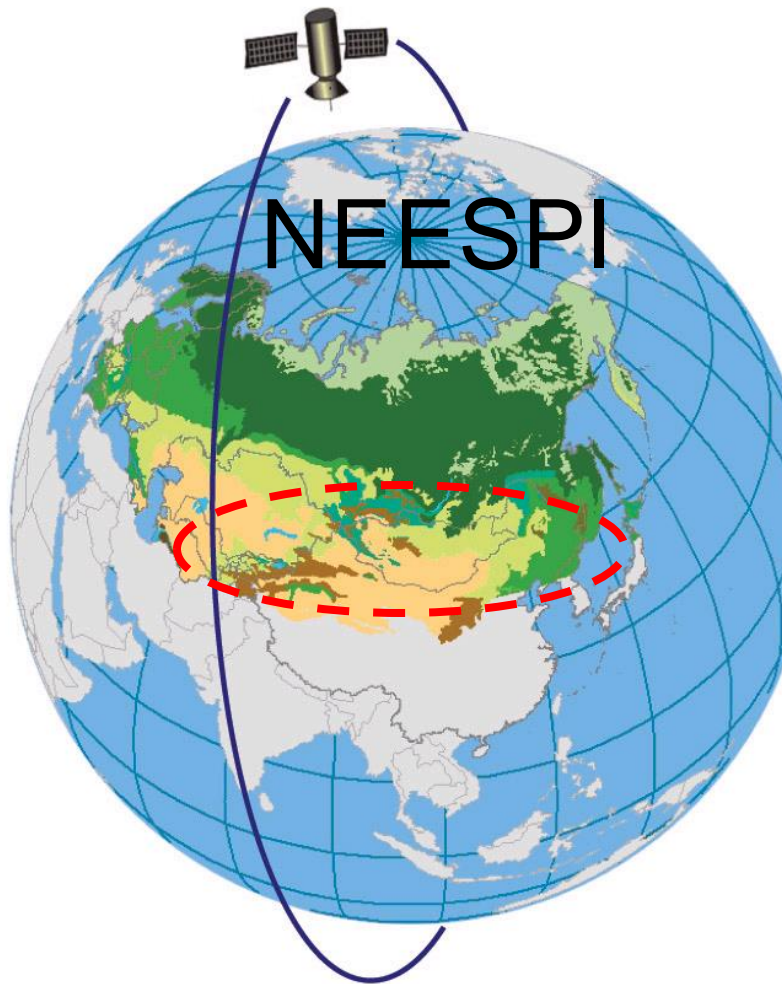
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UCAR Project Scientist at
NCDC
National Climatic Data
Center**

Ailikun

**Director, MAIRS IPO
Beijing, China**

Two Programs, Two Regions Complementary Science Questions



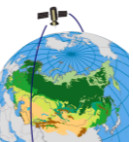
Two Programs

NEESPI

- NEESPI is an interdisciplinary program of internationally-supported Earth systems and science research that addresses large-scale and long-term manifestations of climate and environmental change.
- NEESPI Study Area includes: Former Soviet Union, Northern China, Mongolia, Fennoscandia, & Eastern Europe
- NEESPI duration ~ 10 years (started in 2004)
- <http://neespi.org>

MAIRS

- MAIRS is an international research program, implemented by START, the START TEA-RC and Chinese donors under the ESSP, focusing on human monsoon system interactions.
- Geographic Region: Monsoon Asia.
- Established in 2005
- Funding: Chinese Academy of Sciences
- <http://mairs-essp.org>



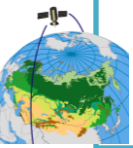
MISSIONS

NEESPI

- To capitalize on a variety of remote sensing and other tools and implement a general modeling framework linking socioeconomic factors, crop, pollution, land use, ecosystem, and climate models with observational data to address key research questions within Northern Eurasia.
- To provide information, which empowers society and decision-makers to plan and react wisely, to mitigate the negative and to benefit from the positive consequences of environmental changes.
- Establish educational activities for students, educators, and the general public

MAIRS

- To better understand how human activities in the region are interacting with and altering natural variability of atmospheric, terrestrial and marine components of the monsoon system;
- To contribute to the provision of a sound scientific basis for sustainable development of monsoon Asia;
- To develop a predictive capacity of estimating changes in global-regional linkages in the earth system and to project the future consequences of such changes.



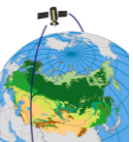
COMPLEMENTS & CONTRAST

NEESPI

- “Biophysical science, on
 - large-scale and long-term manifestations of climate and environmental change.
 - Observations
- Interdisciplinary Approach focusing on:
 - Coastal zone
 - Mountains
 - Steppe-desert
 - Tundra-forest
 - Forest-steppe

MAIRS

- Interface between climate and human, focusing on:
 - Coupling nature of human and environment systems
- Interdisciplinary Approach focusing on:
 - Coastal Zone
 - Mountain Zone
 - Semi arid Zone
 - Urban Zone



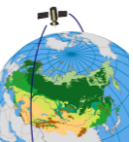
COMPLEMENTS & CONTRAST

NEESPI

- **Affiliated Centers**
 - More than a dozen now
- **Affiliated Projects**
 - Various funding agencies, primarily by NASA
- **Focus Research Center**
 - Numerous the region
- **1 Project Scientist to coordinate**
- **No funding commitment**

MAIRS

- **Well linked to research programs of the region;**
- **Its own funding to support research activities**
- **Project office to coordinate**
- **Committed funding for another 5 years**



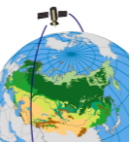
COMPLEMENTS & CONTRAST

NEESPI

- **Fundamental physical and ecological science questions focusing on**
 - Climate
 - Hydrology
 - Biosphere
 - LCLUC

MAIRS

- **Interdisciplinary science questions focusing on the interactions between environment and human systems**
 - LCLUC
 - Socioeconomics
 - Climate and
 - Hydrology



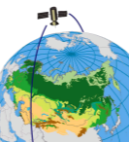
COMPLEMENTS & CONTRAST

NEESPI

- Observations from spaces with limited in-situ data
- Established regional networks
- Observations and modeling

MAIRS

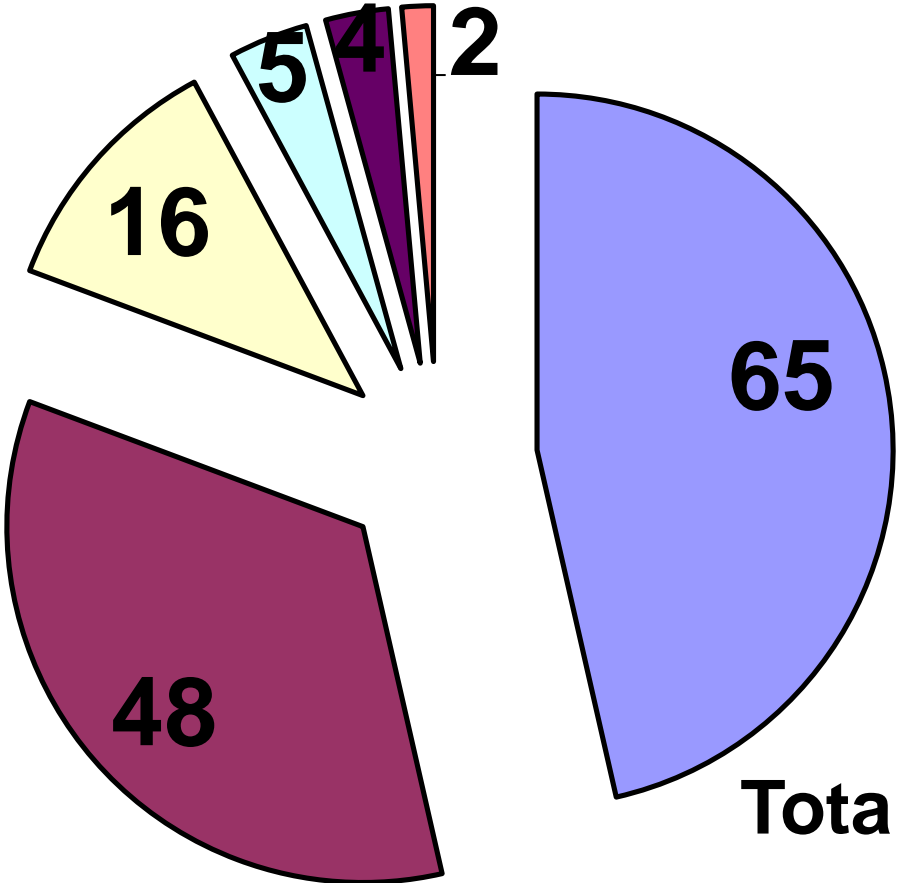
- Established experimental networks (with satellite remote sensing)
- Modeling and statistical approaches



Highlights



Completed and ongoing NEESPI Projects by country (or group of countries), January 2011

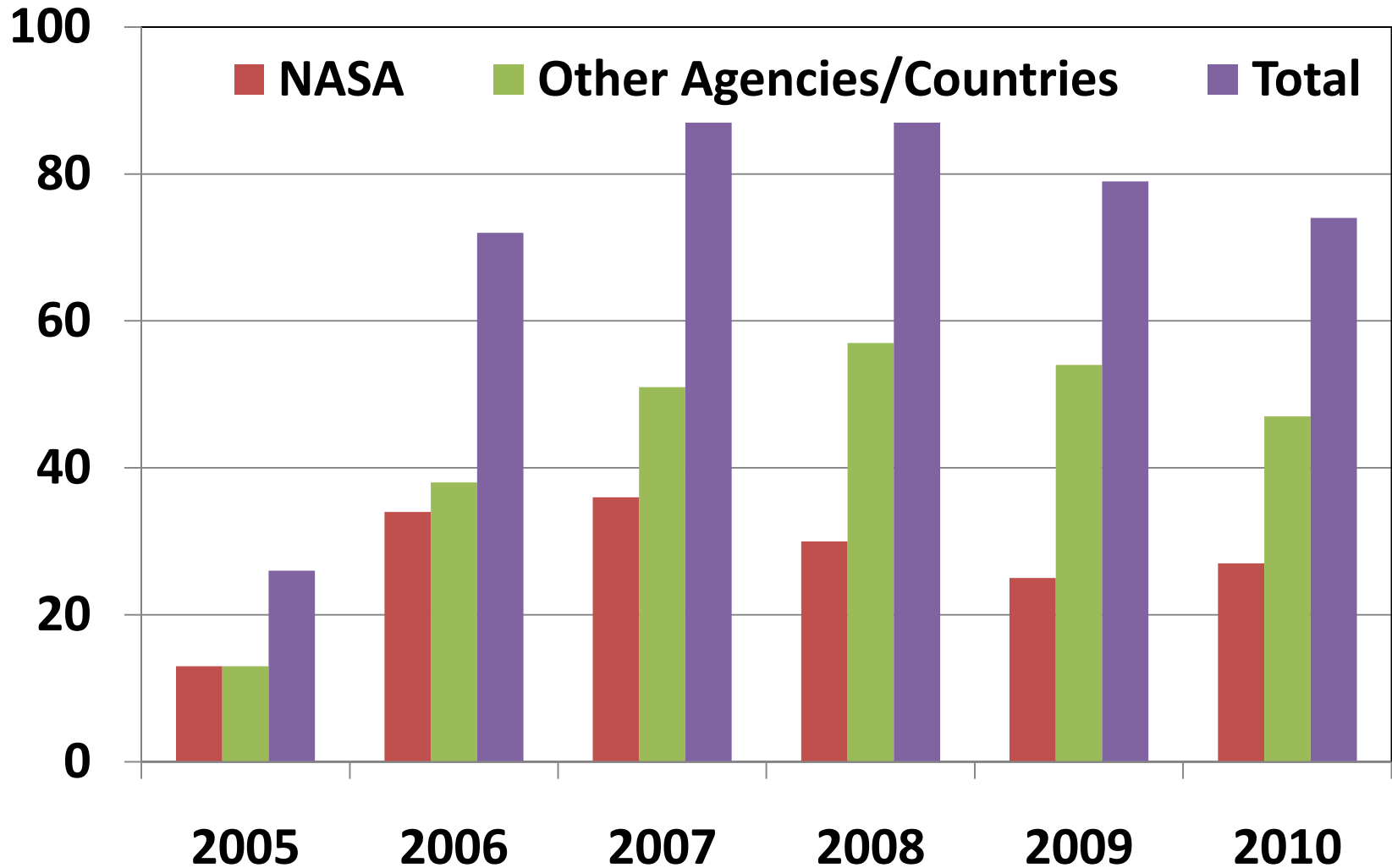


NEESPI projects are grouped by the major national funding source

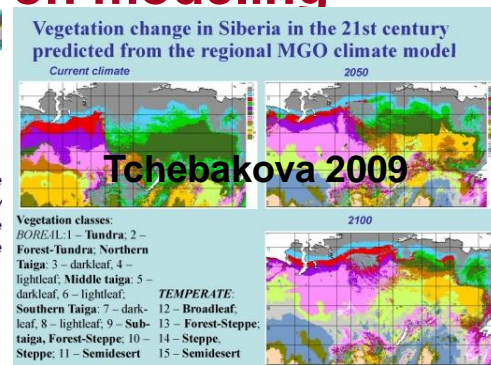
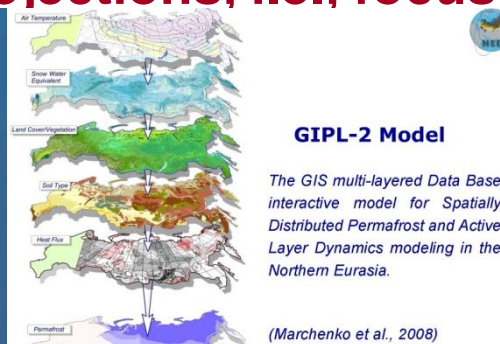
Total 140 Projects

- All US Agencies
- All Russian Agencies
- All EU Agencies
- All Japanese Agencies
- All Chinese Agencies
- Canada

Active Projects per year

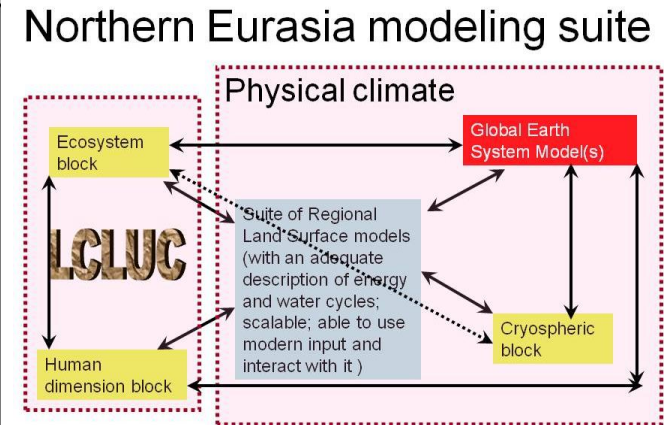
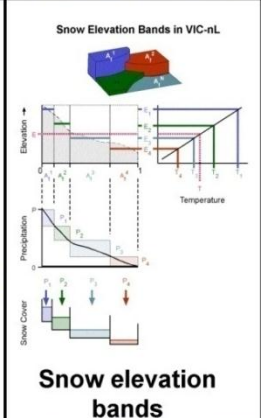
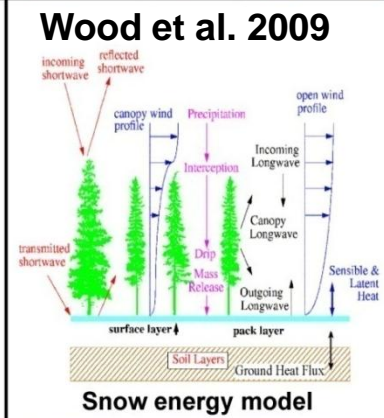
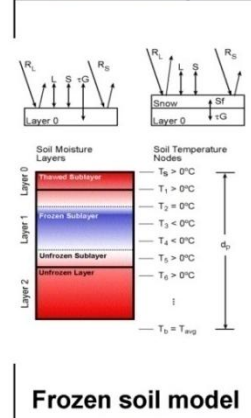
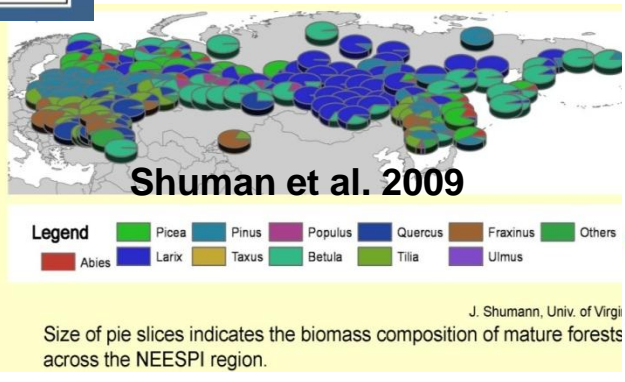
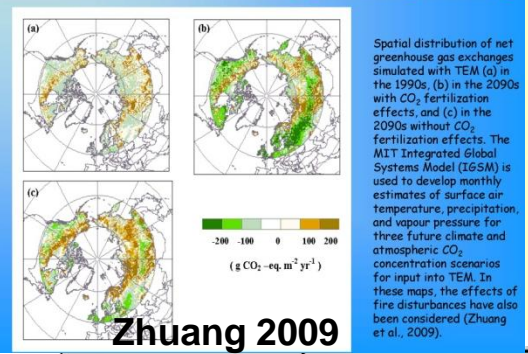


First phase foci of NEESPI were monitoring and analyses. After the NEESPI Workshop in August 2007 at the Aspen Global Change Institute, a new course was accepted towards strengthening of the NEESPI research focus on projections, i.e., focus on modeling



Net Greenhouse Gas Exchanges of CO₂ and CH₄

Efforts are made to blend modern RCMs with vegetation, carbon flux, permafrost, hydrological, and dust production models within a North Eurasia modeling suite and link it to the MIT Earth System model.



Specialty models (or a configuration of models) and/or recent results of their application within the NEESPI domain

- **VMGO Regional Climate Model (Shkolnik et al. 2008, 2010)**
- **Russian Global NWP Model SL-AV at RAS Inst. of Numerical Math. and Hydrometcentre of Russia (Prof. Mikhail Tolstykh, 2009, Personal Communication)**
- **MIT Earth System Model (Sokolov et al. 2009)**
- **Coupled regional modeling system WRF-DuMO (Darmenova et al. 2009)**
- **Coupling of VMGO RCM with Siberian Biospheric Model (Tchebakova et al. 2009)**
- **Permafrost Dynamic Model (Marchenko et al. 2008)**
- **Terrestrial Ecosystem Model (Zhuang et al. 2009)**
- **Application of GAP model driven by in situ data (Shuman et al. 2009)**
- **Specialty modifications to the VIC Model (Wood, Troy, et al. 2009) and the WBMPlus at Univ. of New Hampshire (Shiklomanov et al. 2007, 2009) to simulate/project the changes in the water cycle in the cold regions**

NEESPI Outreach in 2010

During the past 4 years, ~30 dedicated NEESPI Workshops and 8 NEESPI Open Science Sessions at the International Meetings were convened and more than 500 papers and books were published.

The past year was extremely productive in the NEESPI outreach. Several PhD students defended their theses in 2010 while working within the NEESPI framework. In 2010, *more than 150 peer-reviewed papers and/or book chapters were published or are in press* (this list is still incomplete and is anticipated to increase; cf., http://neespi.org/science/NEESPI_publications.pdf)

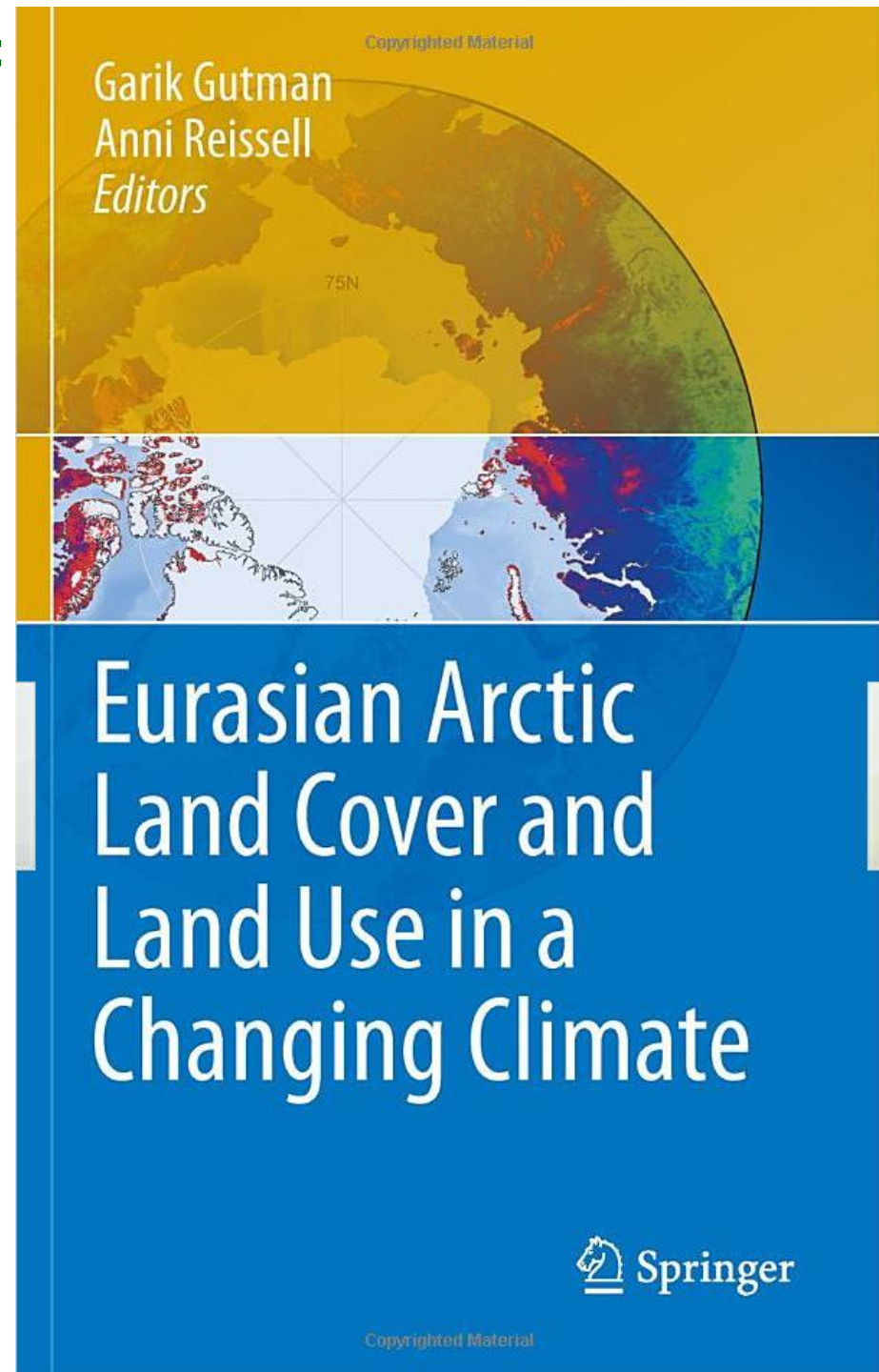
In particular:

Several books and White Papers were published by Springer (Balzter, ed., 2010; Gutman and Reissell, eds., 2011), the National Academy of Science of Ukraine (Lyalko, 2010), and FAO (Mátyás, 2010).

Gutman, G. and A. Reissell (eds.), 2011:
***Arctic land cover and land use in a
changing climate: Focus on Eurasia.***
Springer, Amsterdam, The Netherlands,
306 pp.

The Book include chapters devoted to

- the Arctic climatic change
- the Arctic vegetation change, carbon cycle change and their interactions
- the Arctic hydrological changes and their interactions with LCLUC
- the Arctic LCLUC impact on reindeer pastoralism
- the Arctic integrated LCLUC impact in the region of most intense human activity in Eurasian Arctic
- the Arctic interaction of Arctic aerosols and LCLUC., and
- the use of remote sensing in studying all the above aspects of the Eurasian Arctic changes



Current NEESPI activities:

- Book **“Environmental Changes in Siberia: Regional Changes and their Global Consequences”** is in preparation
- The **4th NEESPI Special issue** *Environ. Res. Lett.* is being composed from papers of presenters at the 2010 NEESPI meetings, workshops, and open sessions [up to mid-June 2011]

NEESPI Sessions/Conferences in 2011:

- **April 3-8, 2011, Vienna, Austria. NEESPI Session at the EGU Assembly**
- **May 22-27, 2011, Makuhari Messe, Japan. Japanese Geoscience Union Annual Meeting.** The NEESPI special Multidisciplinary Session M-IS03; "Changes in Northern Asia and their feedbacks to the Globe")
- **July 3-13, 2011, Tomsk, Russia. "CITES 2011" Event** (International Conference and Young Scientists School on Computational Information Technologies for Environmental Sciences)
- **July 18-20, 2011, Kaifeng, China** Workshop on Dryland Ecosystems in the NEESPI/MAIRS Domains
- **August 15-21, 2011, Krasnoyarsk, Russia.** International Boreal Forest Research Association (IBFRA), Science Conference
- **December 2011, San Francisco, USA,** NEESPI Session at the Annual Fall AGU Meeting.

NASA LCLUC 2011 Call(two-phase selection process is on the way).

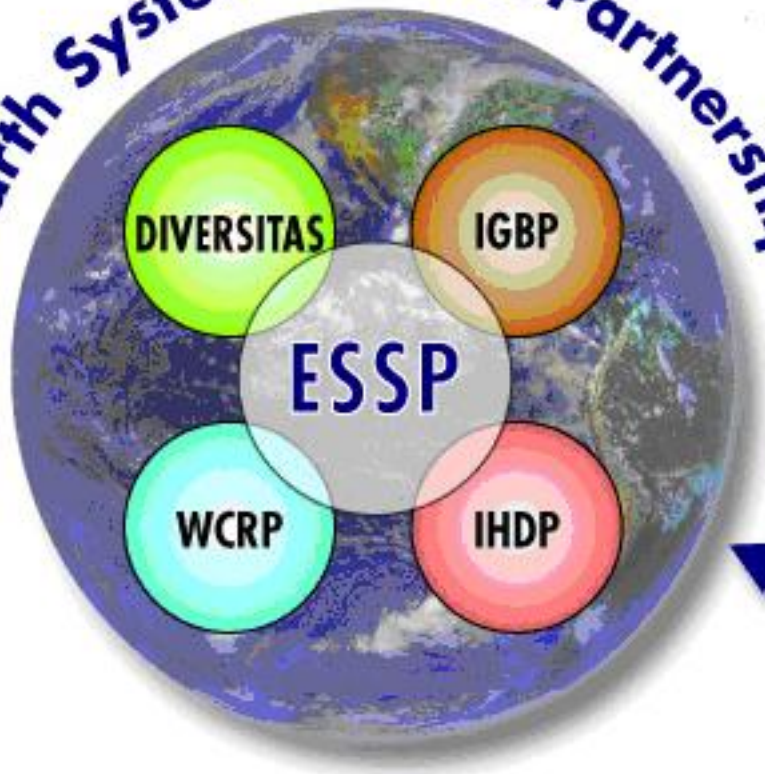
A book in preparation **Environmental Changes in Siberia: Regional Changes and their Global Consequences".**

- **Introduction**
- **Information systems for environmental studies**
- **Climate change**
- **Water cycle changes**
- **Effect of Cryosphere Changes on Infrastructure**
- **Terrestrial ecosystems and their changes**
- **Human dimensions of land cover and land use changes**
- **Atmospheric pollution**
- **Integration and Synthesis**

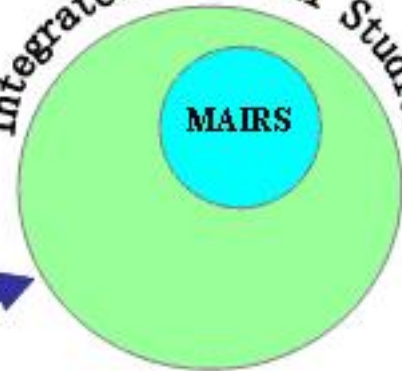
Highlights



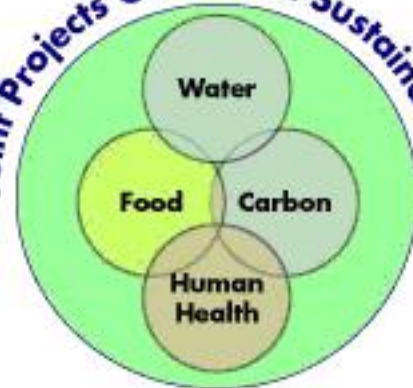
Earth System Science Partnership



Integrated Regional Studies



Joint Projects On Global Sustainability



Key Points of Each Research Zones

Rapid transformation of land and marine resources

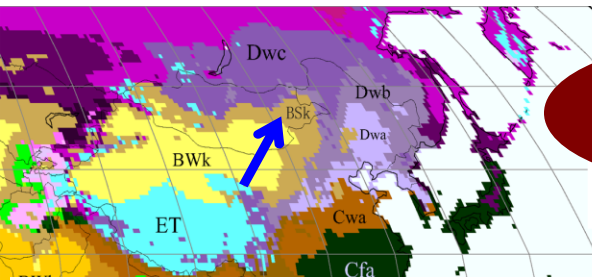
Multiple stresses on ecosystem and biophysical resources

Coastal Zone

Mountain Zone

Semi-arid Zone

Urban Zone



D: semi-arid
E: polar

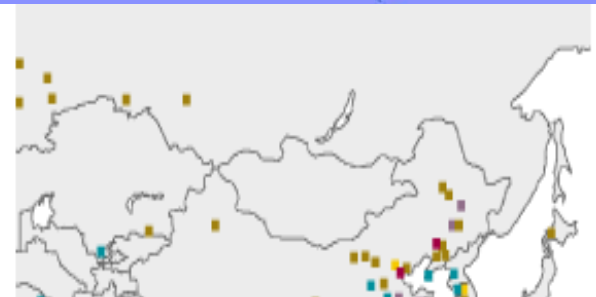
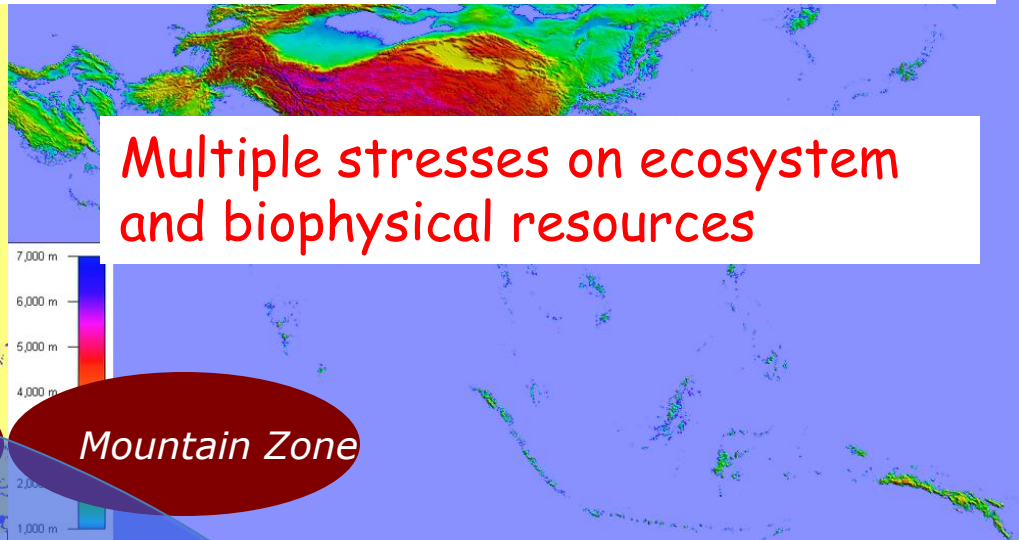
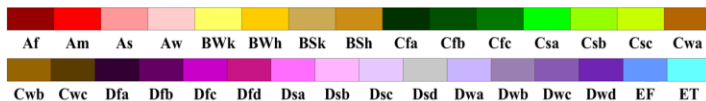
w: winter dry
m: monsoonal

Vulnerability of ecosystem due to changing climate and land use

Changes in resources use and emission due to rapid urbanization

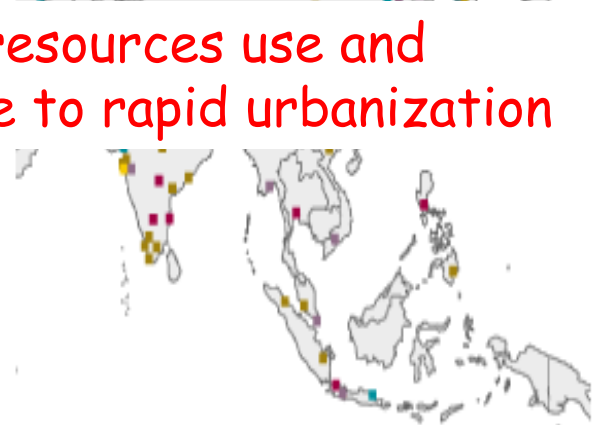


d: extremely continental



2-3 million inhabitants

More than 10 million



Major Activities

- **SSC meeting: 6 total up to now since 2006**
- **Workshops and meetings: ~30 (9 in 09-10)**
- **Regional training: 2 (young scientists and students)**
- **Associated/affiliated projects: ~40 including those funded by LCLUC**
- **Developed large scale regional observation networks in Urban and Drylands**
- **Formation of regional modeling groups (atmosphere and urban-climate models)**
- **Increasingly international**

MAIRS Major Achievements in Last 5 Years

- Successful in developing regional framework, conducting the regional research and promoting the activities.
- Promoted collaborations with ongoing national/international global change research projects, and coordinates joint observations, analysis and modeling
- Took the lead role in coordination and integration among different countries, funding agencies, research institutes and international/national organizations.
- Attracted more scientists and projects from CHINA

Lessons Learned

1. MAIRS activity should be needs driven
2. Monsoon climate should always be the keyword
MAIRS should have its focus!
3. Insufficient funding
4. Although MAIRS has developed many joint projects (such as NASA projects, LACI and MOST-JST projects), more joint projects are needed.
5. Visibility is a general issue.

Future Direction

- Need to identify audiences and end users, including more stakeholders and policy makers of both national and international levels.
- Coastal region should be enhanced or focused studies. Bigger rivers that discharge into the ocean, for ecosystem assessment or disaster.

Future Direction

- Involving more SEA countries and scientists, linking with MAIRS urban and coastal studies
- Improving the modeling capacity in Himalaya Mountains.
- Focus on extreme events

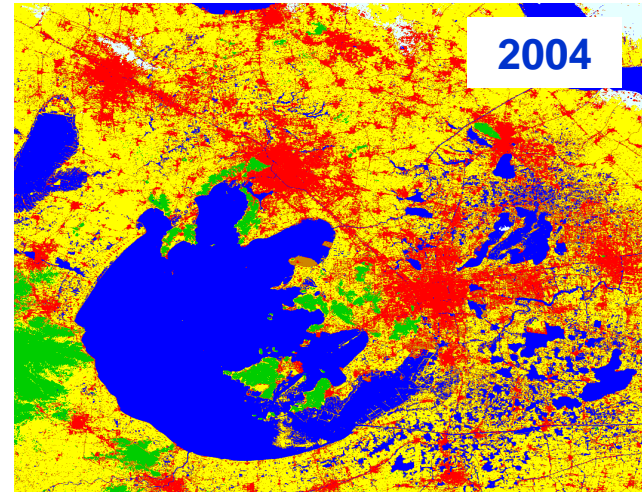
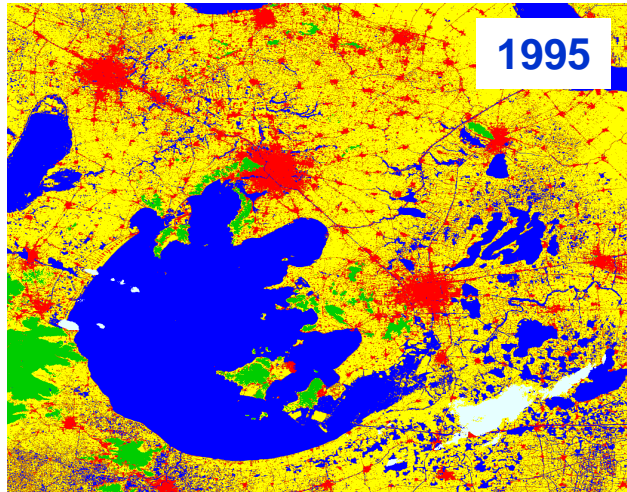
Two Examples

Urban-Climate Interactions

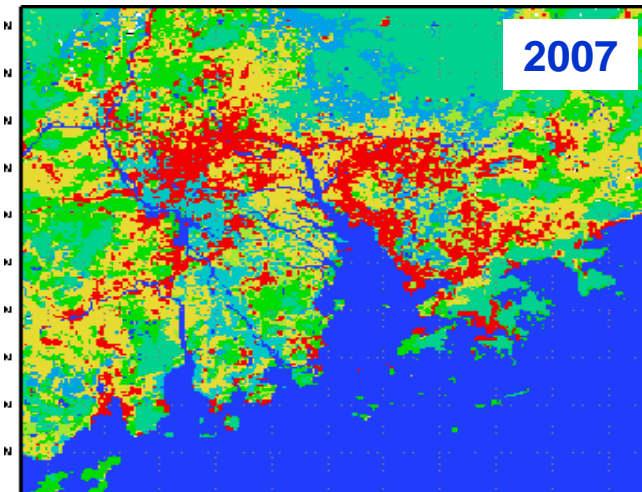
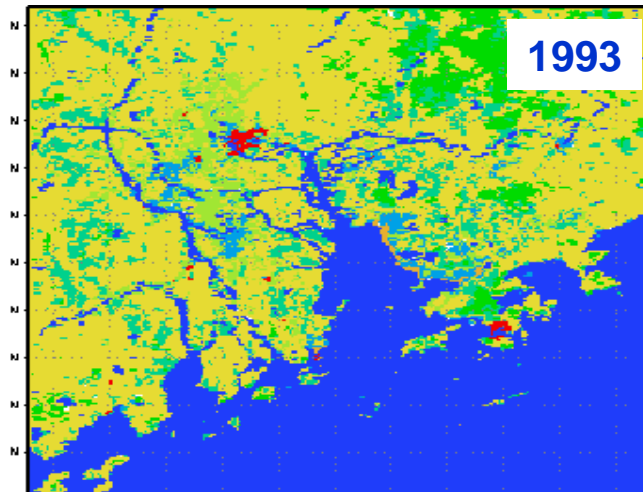
Dryland Ecosystems

Rapid Urbanization in China

Yangtze
River Delta



Pearl River
Delta

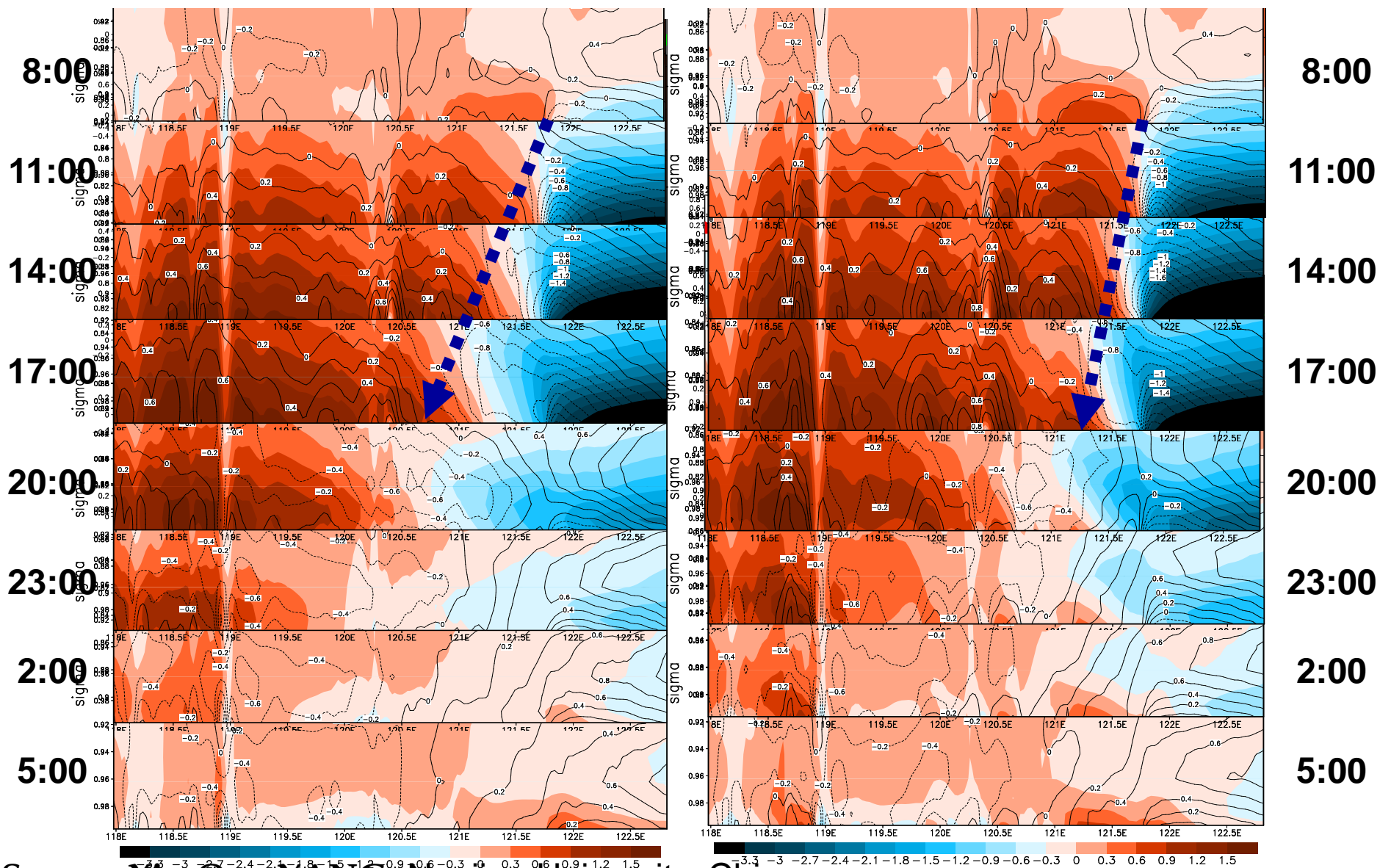


Interaction between UHI circulation & Sea Breeze

(JJA, 2001-2004)

NoUrban

Urban



Source: Xiu-Qun YANG, Nanjing University, China

Probability Density of Hourly Temperature during August

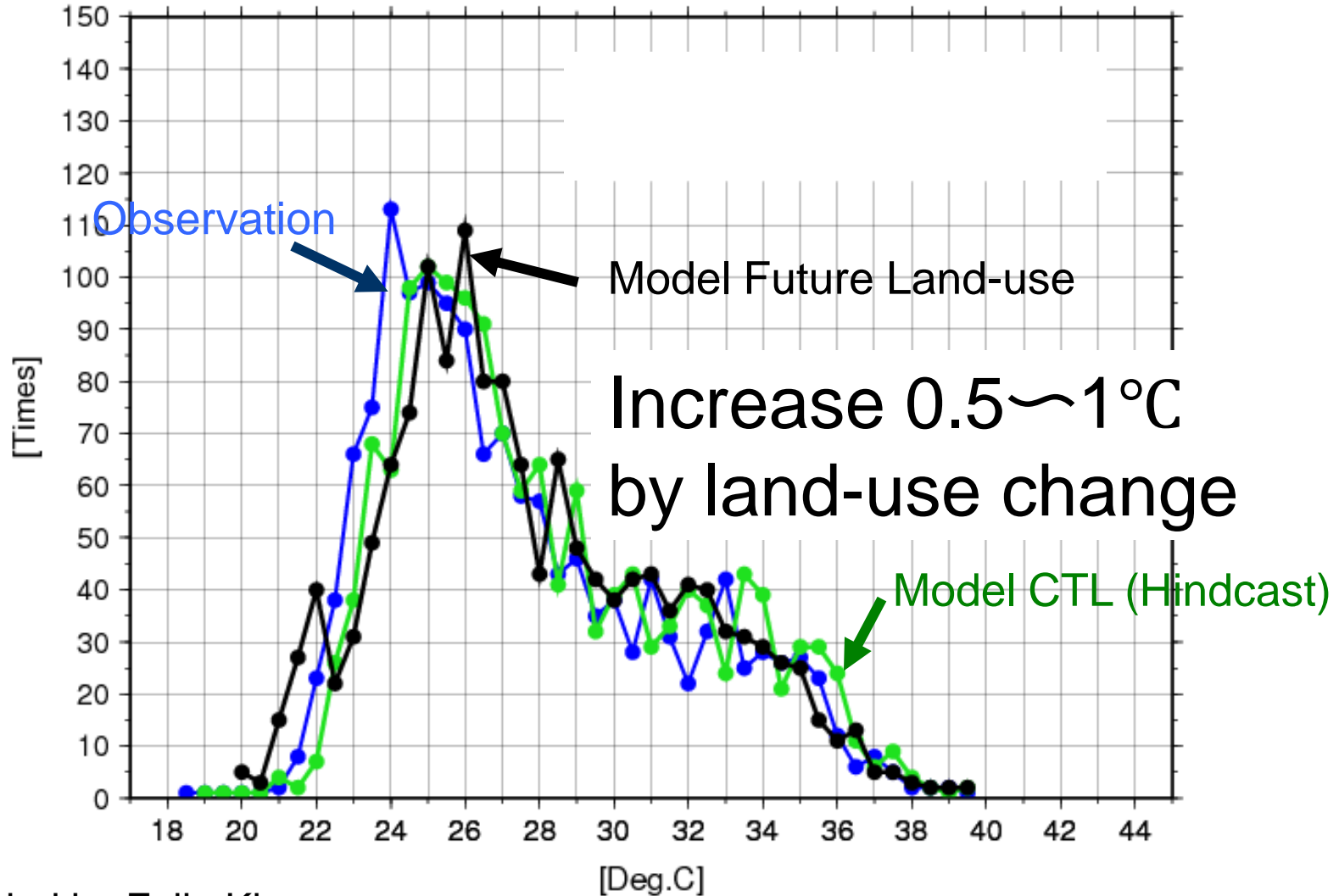
August

Station=kumagaya 2006-2007/08

Frequency of surface temperature at lowest level

Kumagaya

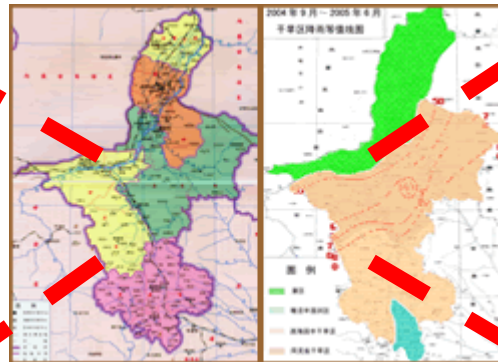
Changing only by urban ratio



Formation of Dryland Working Group

1. Integrate the monitoring system
2. Improve the modeling capacity
3. Coordinate and develop the cross-cutting study for dryland vulnerability assessment and adaptation/mitigation strategies.
4. Enhancing Asian dryland research framework and Capacity building.

How big of the real impacts on agriculture of the drought given the mitigation measures taken?



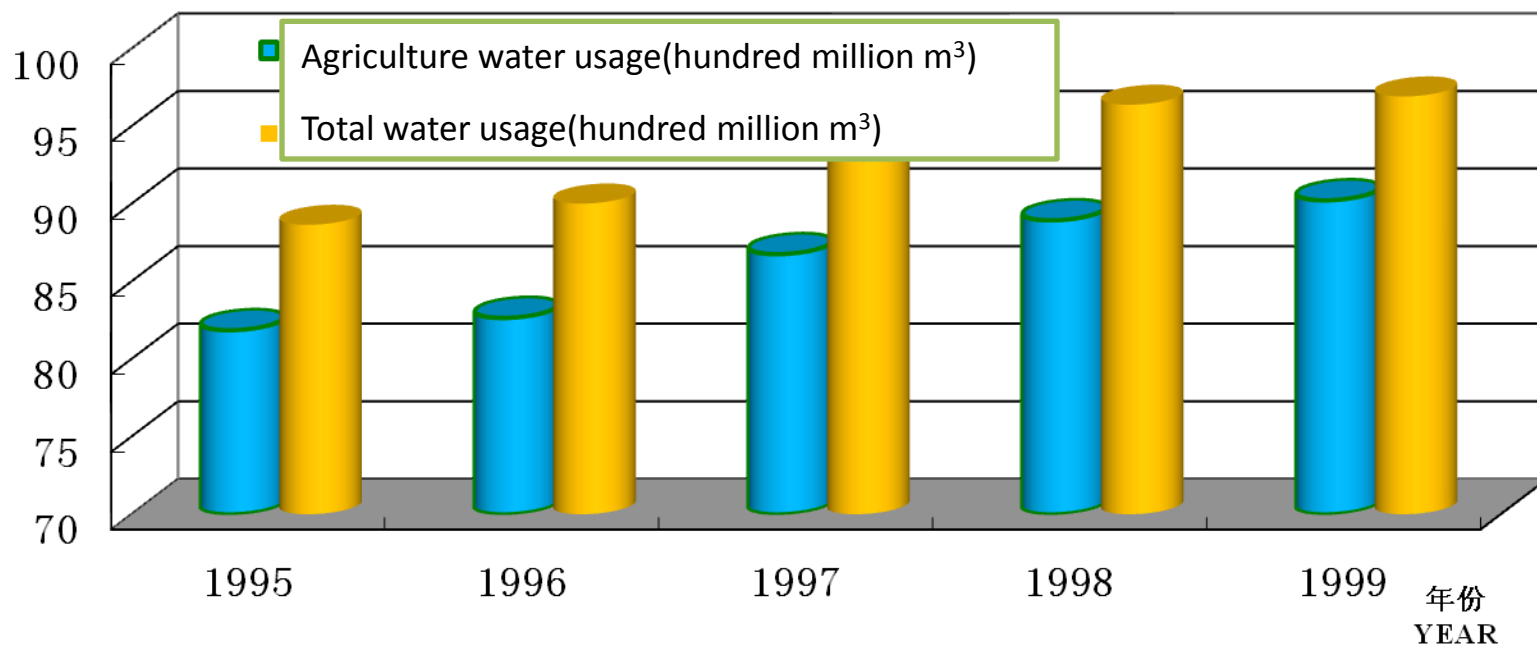
To crop
production: ?%
To household
income: ?%

Impact of climate change on agriculture

- ◆ Expansion of crop sown area conflicts with the available water used for agriculture

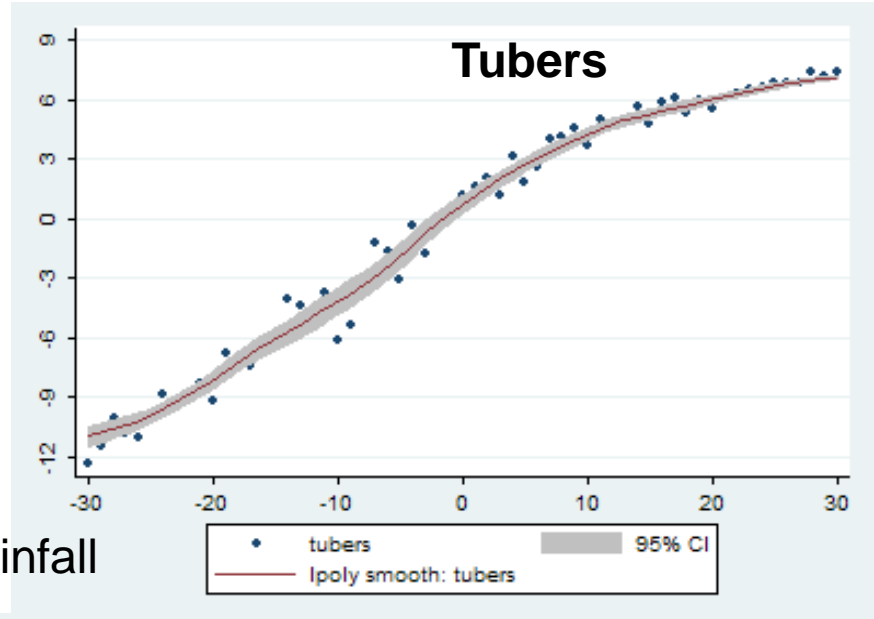
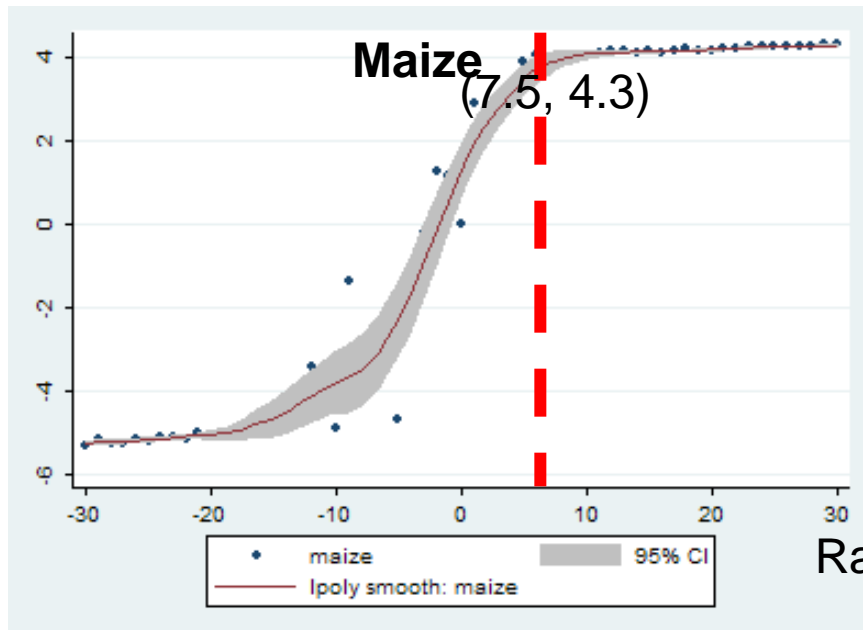
WATER USAGE

The Chang of Water Usage in Ningxia

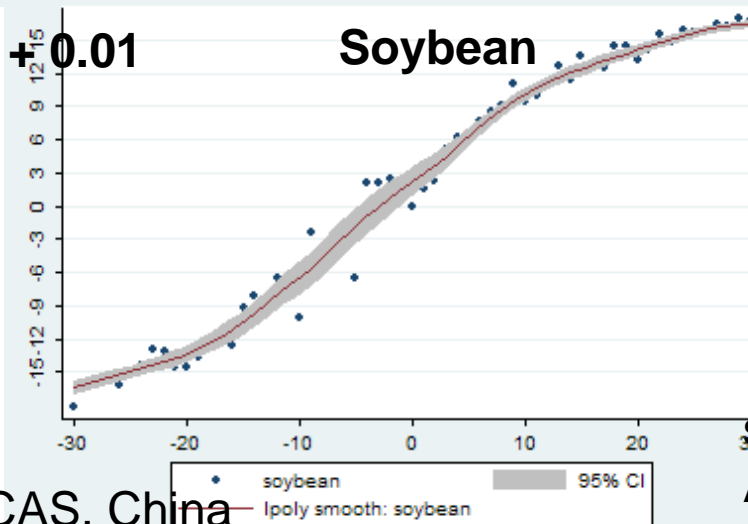


Source: Xiangzhewng DENG, CAS, China

Vulnerability of crop production due to rainfall fluctuation



maize = 0.22 * prec + 0.01
Adj sq R = 0.85



tubers = 0.35 * prec - 0.55
Adj sq R = 0.96

soybean = 0.65 * prec + 1.19
Adj sq R = 0.97

Changes in the
Human-Monsoon System
of East Asia in the
Context of Global Change



editors
Congbin Fu
J R Freney
J W B Stewart

Monsoon Asia Integrated Regional Study on Global Change - Vol 1

 **World Scientific**

Changes In The Human-Monsoon System Of East Asia In The Context Of Global Change (Monsoon Asia Integrated Regional Study on Global Change)

edited by Congbin Fu, J. R. Freney and J W B Stewart (2008)

Two Special issues are in preparation with LCLUC Program:

- a. Tropical SEA and
- b. Dryland Central Asia

In the coming year

- **Dryland Workshops**
 - Harbin (6/8-10/2011)
 - Kaifeng (7/18-20/2011)
- **Ecosystem Model Training (June, 2011)**
- **Urban-modeling meeting (Later this year)**
- **Two special issues (with CLULC)**
 - Dryland (Based on meetings in Urumqi and Almaty)
 - Southeast Asia (Based on Kohn Kaen meeting)
 - Hope to finish all these by June (submission)
 - Journals (Regional Environ. And/or Land Use Science)

Questions?

